

KR 709-3G

Bohrgerät
Drill Rig

Translation of Original Technical Manual

Description
Operation
Maintenance

KLEMM
Bohrtechnik

Postfach / PO Box 1265
D-57484 Drolshagen - Germany
Telephone: +49 (0) 2761 / 705-0
Telefax: +49 (0) 2761 / 705-50
E-mail: klemm-bt@klemm-mail.de
Internet: www.klemm-bohrtechnik.de

Table of Contents

1	Preface	8
2	Customer service	16
3	Defects liability	17
4	Guarantee	19
5	Type plate on the equipment	20
6	EC-Declaration of Conformity	21
7	Intended use	22
7.1	General conditions	22
7.2	Equipment-specific conditions	23
7.3	Improper use	23
8	Safety	24
8.1	Terminology	24
8.1.1	Hazard ratings	24
8.2	General Safety	25
8.2.1	Safety principles	25
8.2.2	General safety instructions	26
8.2.3	Personnel requirements	27
8.2.4	General responsibilities of the operator	29
8.2.5	Danger area and safety distance	30
8.2.6	Safety when handling ropes	32
8.2.7	General information on stability	34
8.3	General references to the avoidance of accidents, damages and excessive wear	36
8.4	Operational safety	38
8.4.1	General	38
8.4.1.1	Safety when working near over-ground or underground media supplies	47
8.4.1.2	Safety when working underground or in enclosed spaces	49
8.4.1.3	Working on slopes	50
8.4.1.4	Safety references for the feed chain of the drill mast	51
8.4.1.5	Safety references for operation of rope winches on drill masts	53
8.4.1.6	Safety references for operation of additional component on the equipment	57
8.4.1.7	Safety instructions to the diesel engine	58

8.5	 Safety information for the general drilling operation	59
8.6	 Safety instructions for drill mast slewing	65
8.7	 Safety instructions for drilling with a continuous flight auger	66
8.7.1	 Safety instructions to the auger cleaner	67
8.7.2	 Using a spot drilling guide for drilling with a continuous flight auger	68
8.7.3	 Using a tool handling system for drilling with a continuous flight auger	68
8.8	 Safety during assembly/mounting and dismantling/removing	69
8.9	 Safety when handling suspended loads and during transport	72
8.10	 Safety during maintenance and environmental protection / waste disposal ...	74
8.10.1	.. General	74
8.10.2	.. Safety when handling hydraulic and pneumatic systems	77
8.10.3	.. Safety when handling with accumulators	79
8.10.4	.. Safety for welding, torch cutting, and grinding	82
8.10.5	.. Safety when handling electrical energy	83
8.10.6	.. Safety when handling auxiliary materials and operating fluids	84
8.10.7	.. Safety in case of contamination risk	85
8.10.8	.. Safety when cleaning the equipment	86
8.11	 Safety and protective equipment	87
8.11.1	.. EMERGENCY-STOP	87
8.11.2	.. Fire extinguishers	88
8.11.3	.. Safety device for the rotation and feed functions (Safety system)	89
8.11.3.1	.. Start-up and functional test of the safety device for the rotation and feed functions	89
8.11.4	.. Safety guard as safety device mounted on the drill mast of the drill rig	91
9	 Danger zones of the drill rig	92
10	 Instruction pictograms at KLEMM equipment	96
11	 Stability of the drill rig KR 709-3G	102
11.1	 Drawing to stability 1019022-00	106
12	 Technical description	107
12.1	 Equipment overview	107
12.1.1	.. Boom overview	108
12.1.2	.. Drill mast overview	109
12.2	 Technical data KR 709-3G	110
12.2.1	.. Dimensions and weight	110
12.2.2	.. Specifications of the equipment	111
12.2.3	.. Permissible ambient temperatures	112
12.2.4	.. Noise emissions	112

12.2.5 .. Exhaust gas emissions	113
12.2.6 .. Vibration acceleration	113
12.2.7 .. Permissible diesel engine inclination angles	113
12.2.8 .. Swivelling ranges	114
13 Operation of the equipment	115
13.1 Working configuration	115
13.2 Access to moving parts	116
13.3 Decision on the work configuration	116
13.3.1 .. Selection of the working configuration, if the access to moving parts is foreseeable	117
13.3.2 .. Selection of the working configuration, if the access to moving parts is not foreseeable	117
13.4 Protective operation modes	118
13.4.1 .. No protective operation mode = OFF	118
13.4.2 .. Restricted operation mode = ROM	118
13.4.3 .. Special protective mode = SPM	119
13.4.3.1 . Automatic switching of SPM into ROM (option)	120
13.4.4 .. Comparison of the operation modes	121
13.4.5 .. Selection of the operation mode	122
14 Operation	123
14.1 Control points on the equipment	123
14.2 Start-up	124
14.2.1 .. Initial start-up	124
14.2.1.1 . Removal of protective wax	124
14.2.2 .. Start-up after long-term shutdown or storage	125
14.2.3 .. Daily start-up	126
14.2.3.1 . Visual check before daily start-up	126
14.2.3.2 . Making the equipment operational	127
14.2.3.3 . Starting the equipment	128
14.2.3.4 . Jump starting the equipment	129
14.2.3.5 . Start-up in cold ambient temperature conditions	130
14.3 Decommissioning	131
14.3.1 .. Brief interruptions or end of work	131
14.3.2 .. Long-term shutdown or storage	131
14.3.3 .. Shutdown	132
14.4 Engine control box with display	133
14.4.1 .. General information to the control unit with display	133
14.4.2 .. Menu diesel engine	138

14.4.2.1 . EATS Warnings and Inducement	139
14.4.3 .. Menu system pressures	140
14.4.4 .. Menu mast inclination	141
14.4.5 .. Menu service	141
14.4.5.1 . Menu display settings	142
14.4.5.2 . Menu machine data	144
14.4.5.3 . Menu engine data	147
14.4.5.4 . Menu controls inputs / outputs	148
14.4.5.5 . Menu operating unit	149
14.4.5.6 . Menu CAN-nodes	151
14.4.5.7 . Menu electric control blocks	153
14.4.5.8 . Menu safety device	154
14.4.5.9 . Menu functions	155
14.4.5.10 Menu system parameters	157
14.4.6 .. Engine Management System (EMS)	158
14.4.6.1 . References to engines with Engine Management System (EMS)	158
14.4.6.2 . References to the Exhaust Aftertreatment System (EATS)	159
14.5 EEP-assist	160
14.6 Operation mode optimized pump power adjustment (Power Sharing)	161
14.7 Driving the equipment	163
14.7.1 .. Manoevrability	163
14.8 Operation control systems electrically controlled equipment	164
14.8.1 .. Start of electrically controlled equipment	166
14.9 Operation of alignment and drilling via radio remote control	167
14.9.1 .. Radio remote control of the drill rig KR 709-3G	167
14.9.1.1 . General	167
14.9.1.2 . Switch on the receiver	178
14.9.1.3 . Switch on and off the radio remote control	179
14.9.1.4 . Operation of the equipment over the radio remote control	185
14.9.1.5 . Display of the remote control	187
14.9.1.6 . Function assignment of the radio remote control in driving mode	188
14.9.1.7 . Function assignment of the radio remote control in alignment mode	190
14.9.1.8 . Function assignment of the radio remote control in drilling mode	192
14.10 ... Signal tower operation modes	195
14.11 ... Load compensation / manually applied load control	196
14.12 ... Temporary retraction force increase / retrieval function	198
14.12.1 . Operating elements of the temporary retraction force increase at the equipment	198
14.13 ... Pressure gauges for the alignment functions and the main drilling functions .	199
14.14 ... Control box at the base unit	200

15	 Transport	203
15.1	 Transport guidelines	203
15.2	 Transport mode	204
15.2.1	.. Before loading	204
15.2.2	.. After loading	205
15.2.3	.. Lifting the equipment	205
15.2.3.1	.. Cross bar with hoisting ropes for crane loading of the equipment	206
15.2.4	.. Lashing the equipment	206
15.2.5	.. Align the drill mast in transport position	207
16	 Maintenance/repair	208
16.1	 General	208
16.1.1	.. Expert inspection	208
16.1.2	.. Maintenance intervals	209
16.1.3	.. Hoses	209
16.1.4	.. Connection elements	209
16.1.5	.. Welding	209
16.1.6	.. Pressure tank	209
16.1.7	.. Cylinders	210
16.1.8	.. Bearings and bearing pins	212
16.1.9	.. Additional components on the equipment	212
16.2	 Scope of the 100 hour inspection	213
16.3	 Maintenance table	214
16.3.1	.. Changing clamping chucks on the clamping devices	220
16.4	 Lubricants	221
16.4.1	.. Lubricants table	221
16.4.2	.. Characteristics of different hydraulic oils for KLEMM Bohrtechnik equipment	223
16.5	 Hydraulic system	225
16.5.1	.. Hydraulic tank	225
16.5.2	.. Filter and filter inserts in the hydraulic system	227
16.5.3	.. Cooling system hydraulic oil	228
16.5.4	.. Checking of pump pressures at the equipment	229
16.6	 Pump distributor gear	229
16.7	 Diesel engine	230
16.7.1	.. Cooling system of the diesel engine	230
16.7.2	.. Lubricating oil system of the diesel engine	230
16.7.3	.. Filter diesel engine	231
16.8	 Undercarriage	241
16.8.1	.. Check the chain tension	241

16.8.2 .. Adjusting the chain tension	242
16.8.3 .. Wear limits of the crawler chains	244
16.8.4 .. Check oil level / change oil of driving gear	245
16.9 Electrical system	247
16.9.1 .. Checking the batteries	247
16.9.2 .. Checking the fuses	247
16.10 ... Fire extinguishers	247
16.11 ... Steps/platforms/handrails	248
17 Environmental protection/disposal	249
17.1 General	249
17.2 Storing and transporting equipment, units, consumables and operating materials	249
17.3 Information on cleaning the equipment	250
17.4 Shutdown	250
17.5 Disassembling the equipment	250
17.6 Disposal	251
17.6.1 .. Disposing of operating materials, lubricants and consumables	251
17.6.2 .. Disposing of metal components and synthetics	251
17.6.3 .. Disposing of electrical and electronic components	251
17.6.4 .. Hazardous waste	252
17.6.5 .. Recycling	252

1 Preface

- UK** You may not commission the device / system if you do not understand the language used in this instruction manual. In this case, contact the customer service department at KLEMM Bohrtechnik GmbH and order an instruction manual in a language you understand.

Telephone +49 2761 / 705 0
Telefax +49 2761 / 705 50
E-mail klemm-bt@klemm-mail.de

- BG** Не пускайте в експлоатация уреда / съоръжението, ако не разбирате езика, на който е изготвено настоящото упътване за експлоатация. В този случай се свържете със Службата за клиенти на KLEMM Bohrtechnik GmbH и поръчайте упътване за експлоатация на разбираем за Вас език.

Телефон +49 2761 / 705 0
Телефакс +49 2761 / 705 50
E-Mail klemm-bt@klemm-mail.de

- CZ** Pokud neovládáte jazyk, kterým je napsán tento provozní návod, nesmíte přístroj / zařízení uvádět do provozu. V tom případě se obraťte na oddělení služeb zákazníkům společnosti KLEMM Bohrtechnik GmbH a objednejte si provozní návod v jazyce, který ovládáte.

Telefon +49 2761 / 705 0
Fax +49 2761 / 705 50
E-mail klemm-bt@klemm-mail.de

- DE** Sollten Sie die in dieser Bedienungsanleitung verwendete Sprache nicht verstehen, darf das Gerät / die Anlage von Ihnen nicht in Betrieb genommen werden. Kontaktieren Sie bitte in so einem Fall den Kundendienst der KLEMM Bohrtechnik GmbH und bestellen Sie eine Betriebsanleitung in einer für Sie verständlichen Sprache.

Telefon +49 2761 / 705 0
Telefax +49 2761 / 705 50
E-Mail klemm-bt@klemm-mail.de

- DK** Hvis De ikke forstår det anvendte sprog i denne driftsvejledning, må udstyret/ anlægget ikke tages i drift. Kontakt i et sådant tilfælde KLEMM Bohrtechnik GmbH's kundeservice, og bestil en driftsvejledning på et sprog, De forstår.

Telefon +49 2761 / 705 0
Telefax +49 2761 / 705 50
E-Mail klemm-bt@klemm-mail.de

ES

Si no entiende ninguno de los idiomas en los que está escrito este manual de instrucciones, no debe poner en funcionamiento el equipo/la instalación. En este caso, póngase en contacto con el servicio de atención al cliente de KLEMM Bohrtechnik GmbH y pida un manual de instrucciones en un idioma que entienda.

Teléfono +49 2761 / 705 0
Telefax +49 2761 / 705 50
Correo electrónico klemm-bt@klemm-mail.de

EE

Kui te ei oska keelt, milles käesolev kasutusjuhend on koostatud, ei tohi te seadet/süsteemi kasutusele võtta. Palun võtke sellisel juhul ühendust KLEMM Bohrtechnik GmbH klienditeenistusega ja tellige kasutusjuhendi eksemplar teile arusaadavas keeles.

Telefon +49 2761 / 705 0
Faks +49 2761 / 705 50
E-post klemm-bt@klemm-mail.de

FI

Jos ette ymmärrä näiden käyttöohjeiden kieltä, ette saa ottaa laitetta/laitteistoa käyttöön. Ottakaa siinä tapauksessa yhteyttä KLEMM Bohrtechnik GmbH:n asiakaspalveluun ja tilatkaa käyttöohjeet sellaisella kielellä laadittuna, jota ymmärrätte.

Puhelin +49 2761 / 705 0
Telefax +49 2761 / 705 50
E-Mail klemm-bt@klemm-mail.de

FR

Si vous en comprenez pas la langue employée dans ces instructions de service, vous ne devez pas mettre cet appareil ou cette installation en service. Dans un tel cas, contactez le service clientèle de KLEMM Bohrtechnik GmbH et commandez des instructions de service dans une language que vous maîtrisez.

Téléphone +49 2761 / 705 0
Télécopie +49 2761 / 705 50
E-mail klemm-bt@klemm-mail.de

GR

Αν δεν καταλαβαίνετε τη γλώσσα αυτών των οδηγιών λειτουργίας, δεν επιτρέπεται να θέσετε τη συσκευή ή την εγκατάσταση σε λειτουργία. Σε μια τέτοια περίπτωση ελάτε σε επαφή με το τμήμα εξυπηρέτησης πελατών της KLEMM Bohrtechnik GmbH και παραγγείλετε τις οδηγίες λειτουργίας σε μια γλώσσα που καταλαβαίνετε.

Τηλέφωνο +49 2761 / 705 0
Φαξ +49 2761 / 705 50
E-Mail klemm-bt@klemm-mail.de

HR Ako ne razumijete jezike korištene u ovim uputama za uporabu, onda uređaj / sustav ne smijete stavljati u pogon. U takvom slučaju stupite u kontakt sa servisnom službom tvrtke KLEMM Bohrtechnik GmbH i naručite upute za uporabu na nekom jeziku koji razumijete.

Telefon +49 2761 / 705 0
Telefaks +49 2761 / 705 50
E-pošta klemm-bt@klemm-mail.de

HU Amennyiben Ön nem érti ennek az üzemeltetési utasításnak a nyelvét, nem szabad üzembe helyeznie a készüléket/berendezést. Ebben az esetben értesítse a KLEMM Bohrtechnik GmbH ügyfélszolgálatát és rendeljen egy üzemeltetési utasítást az Ön számára érthető nyelven.

Telefon +49 2761 / 705 0
Telefax +49 2761 / 705 50
E-mail klemm-bt@klemm-mail.de

IT Se non comprendete la lingua utilizzata nelle presenti istruzioni per l'uso, non potete mettere in funzione l'apparecchio/l'impianto. In questo caso rivolgetevi al servizio di assistenza clienti della ditta KLEMM Bohrtechnik GmbH e ordinate le istruzioni per l'uso redatte in una lingua per voi comprensibile.

Telefono +49 2761 / 705 0
Fax +49 2761 / 705 50
E-mail klemm-bt@klemm-mail.de

LT Jei nesuprantate šioje vartotojo instrukcijoje vartojamos kalbos, Jūs negalite eksploatuoti prietaiso / įrenginio. Susisiekite su klientų „KLEMM Bohrtechnik GmbH“ aptarnavimo tarnyba ir užsisakykite instrukciją Jums suprantama kalba.

Telefonas +49 2761 / 705 0
Faksas +49 2761 / 705 50
El. paštas klemm-bt@klemm-mail.de

LU Wann Dir d'Sprooch déi an dëser Betribsuleedung benotzt gëtt net verstitt, dierft Dir den Apparat/d'Anlag net a Betrib huelen. Kontaktéiert an esou engem Fall w.e.g. de Konnendéngscht vun der KLEMM Bohrtechnik GmbH a bestellst eng Betribsuleedung an enger Sprooch déi Dir verstitt.

Telefon +49 2761 / 705 0
Telefax +49 2761 / 705 50
E-Mail klemm-bt@klemm-mail.de

LV

Ja jūs nesaprotat šajā lietošanas instrukcijā lietoto valodu, jūs nedrīkstat sākt šīs ierīces / iekārtas ekspluatāciju. Šādā gadījumā sazinieties ar uzņēmuma KLEMM Bohrtechnik GmbH klientu dienestu un pasūtiet lietošanas instrukciju jums saprotamā valodā.

Tālrunis: +49 2761 / 705 0
Fakss: +49 2761 / 705 50
E-pasts: klemm-bt@klemm-mail.de

MT

Jekk mintix familjari mal-lingwa użata f'dan il-manwal ta' tħaddim, ma għandekx tħaddem dan l-apparat / sistema. Jekk ma tistax taqra dan il-manwal ta' tħaddim jew inkella jekk ma tistax tifhem il-kontenut tiegħu, għandek tikkuntattja liddipartiment tas-servizz tal-klijenti ta' KLEMM Bohrtechnik GmbH u għandek tordna manwal f'lingwa li tifhem.

Telefon +49 2761 / 705 0
Fax +49 2761 / 705 50
E-Mail klemm-bt@klemm-mail.de

NL

Indien u de taal in deze gebruiksaanwijzing niet begrijpt, mag het apparaat / de installatie niet door u worden gebruikt. Neem in dat geval contact op met de klantendienst van KLEMM Bohrtechnik GmbH en bestel een gebruiksaanwijzing in een taal die u begrijpt.

Telefoon +49 2761 / 705 0
Fax +49 2761 / 705 50
E-mail klemm-bt@klemm-mail.de

NO

Hvis du ikke forstår språket som brukes i denne driftsveiledningen, må ikke enheten/anlegget settes i drift. Ta i så fall kontakt med kundeservice hos KLEMM Bohrtechnik GmbH og bestill en driftsveiledning på et språk du forstår.

Telefon +49 2761 / 705 0
Telefaks +49 2761 / 705 50
E-post klemm-bt@klemm-mail.de

PL

Jeśli instrukcja obsługi jest w nieznanym języku obcym, nie wolno włączać urządzenia/instalacji do eksploatacji. W takim przypadku należy się skontaktować z działem obsługi klienta firmy KLEMM Bohrtechnik GmbH i zamówić instrukcję obsługi w znanym sobie języku.

Telefon +49 2761 / 705 0
Telefaks +49 2761 / 705 50
e-mail klemm-bt@klemm-mail.de

PT

Se não compreender a língua utilizada neste manual de instruções, não pode colocar o aparelho/a instalação em funcionamento. Neste caso, queira contactar a assistência ao cliente da KLEMM Bohrtechnik GmbH e encomende um manual de instruções na língua pretendida.

Telefone +49 2761 / 705 0
Fax +49 2761 / 705 50
E-Mail klemm-bt@klemm-mail.de

RO

În cazul în care nu înțelegeți limba în care sunt scrise aceste instrucțiuni de exploatare, nu aveți voie să puneți dumneavoastră în funcțiune aparatul / instalația. În acest caz, luați legătura cu departamentul pentru clienți al firmei KLEMM Bohrtechnik GmbH și comanda instrucțiunile de exploatare într-o limbă pe care o înțelegeți.

Telefon +49 2761 / 705 0
Telefax +49 2761 / 705 50
E-Mail klemm-bt@klemm-mail.de

RU

Если вы не понимаете язык, на котором написана данная инструкция по эксплуатации, ввод устройства / установки в эксплуатацию запрещается. В этом случае свяжитесь с отделом обслуживания компании KLEMM Bohrtechnik GmbH и закажите инструкцию по эксплуатации на языке, который вам понятен.

Тел. +49 2761 / 705 0
Факс +49 2761 / 705 50
E-Mail klemm-bt@klemm-mail.de

SE

Om du inte förstår språket i den här bruksanvisningen får du inte ta utrustningen/ anläggningen i drift. Kontakta i sådant fall KLEMM Bohrtechnik GmbH:s kundtjänst för att beställa en bruksanvisning på ditt språk.

Telefon +49 2761 / 705 0
Telefax +49 2761 / 705 50
E-post klemm-bt@klemm-mail.de

SK

Ak by ste nerozumeli jazyku, v ktorom je tento návod na prevádzku napísaný, nesmiete uviesť prístroj/zariadenie do prevádzky. V tomto prípade kontaktujte zákaznícky servis firmy KLEMM Bohrtechnik GmbH a objednajte si návod na prevádzku v jazyku, ktorému rozumiete.

Telefón +49 2761 / 705 0
Telefax +49 2761 / 705 50
E-mail klemm-bt@klemm-mail.de

SI

Če ne razumete jezika, v katerem je napisano to navodilo za obratovanje, naprave / sistema ne smete uporabljati. V takem primeru se obrnite na službo za podporo strankam podjetja KLEMM Bohrtechnik GmbH in naročite navodilo za obratovanje v jeziku, ki ga razumete.

Telefon +49 2761 / 705 0
Telefaks +49 2761 / 705 50
E-pošta klemm-bt@klemm-mail.de

TR

Bu işletim kılavuzunda kullanılan dili anlamadığınız takdirde cihazı / sistemi çalıştırmanız yasaktır. Bu durumda lütfen KLEMM Bohrtechnik GmbH firmasının müşteri hizmetleri ile iletişime geçiniz ve anlayabileceğiniz dilde bir işletim kılavuzu sipariş ediniz.

Telefon +49 2761 / 705 0
Telefaks +49 2761 / 705 50
E-posta klemm-bt@klemm-mail.de

UA

Якщо ви не розумієте мову, яка використовується в цьому керівництві з експлуатації, вам не дозволяється вводити цей пристрій/цю установку в експлуатацію. В такому випадку зверніться до сервісної служби KLEMM Bohrtechnik GmbH і замовте керівництво з експлуатації на зрозумілій вам мові.

Телефон +49 2761 / 705 0
Телефакс +49 2761 / 705 50
Ел. пошта klemm-bt@klemm-mail.de

Preface

This instruction manual is intended for operating and maintenance personnel and must be retained for later use.

Before using this equipment, please do the following:

First, carefully read the instruction manual.

Always keep this manual with the equipment so you can review it at any time.

This instruction manual provides a detailed description of the equipment, guidelines for transport and start-up, as well as comprehensive instructions for operating the equipment, troubleshooting tips and information on maintenance.

Technical data, weights and measurements apply to the date on which this instruction manual was published. We are constantly improving our products. As a result, the technical data, weights and measurements in this instruction manual may differ slightly from those of the actual equipment delivered. However, these minor differences are inconsequential and do not affect or invalidate the contents of this instruction manual.

Your equipment may have features that differ slightly from those described and illustrated in this instruction manual. This is because we customize equipment based on the needs of individual customers. These differences may not be used as a basis for claims of any kind.

The equipment may not be used for any other purposes than the applications listed in the instruction manual. The manufacturer will assume no liability for the improper or unauthorized use of the equipment, operator errors or improper or inadequate maintenance.

The "Safety Information" section of this instruction manual contains instructions and other information on the safe use of the equipment. The instructions in that section must be followed at all times.

In addition, read and follow all the instructions in the included documents from component manufacturers.

Preface

This instruction manual was written and published by

KLEMM
Bohrtechnik

Wintersohler Str. 5
D-57489 Drolshagen
Tel: +49 (0) 2761 705-0
Fax: +49 (0) 2761 705-50

Copyright 2018, KLEMM Bohrtechnik GmbH

The information contained in this instruction manual and/or any of its parts, sections or sub-sections, is the intellectual property of KLEMM Bohrtechnik GmbH and is protected by domestic and international copyright and other intellectual property laws.

The information in this manual is provided for operating, servicing, maintaining and troubleshooting the equipment described in this document.

We strictly prohibit any duplication, reproduction, translation, microfilming, electronic or magnetic storage or processing, copying or dissemination of these materials and/or the information contained herein, or any part thereof, with the exception of internal use by KLEMM Bohrtechnik GmbH or its authorized external suppliers, consultants or agents, without the prior written consent of KLEMM Bohrtechnik GmbH.

All legal rights and remedies are hereby expressly reserved.

Violators will be prosecuted.

KLEMM Bohrtechnik assumes no liability for use of the information contained herein in a prohibited fashion by any person or entity in any location.

KLEMM Bohrtechnik GmbH reserves the right to change, delete or otherwise modify any information contained herein, or the equipment itself, at any time and for any reason, with or without prior notice.

2 Customer service

Whenever you contact our Customer Service Department, please provide the following information so we can process your request more efficiently.

Description of equipment

- Equipment type
- Serial number
- Hours of operation

Description of damage

- Date (DD.MM.YYYY)
- Cause of damage (if known)
- Type of damage
- Extent of damage (which components might be defective/damaged?)

Your contact information

- Contact name
- Phone / fax / e-mail

Description of job site

- Job site designation/job site name
- Full address
- Directions for Customer Service personnel (if necessary)

Contact information for Customer Service:

KLEMM Bohrtechnik GmbH
Customer Service Department
Wintersohler Str. 5
D-57489 Drolshagen
Phone +49 2761 / 705 0
Fax +49 2761 / 705 50

3 Defects liability

Whenever contractual agreements include defects liability clauses, the following information applies to claims processing.

Defects liability period:

The defects liability period is defined in the contractual agreement.

Terms of defects liability:

- During the defects liability period, only original KLEMM Bohrtechnik replacement parts may be used.
- Damaged components and functional modules may not be dismantled or repaired by the customer during the defects liability period without the permission of the manufacturer, as the manufacturer is entitled to perform repairs.
- Once a defect is found, to prevent subsequent damage, KLEMM Bohrtechnik must be immediately notified in writing using the "Defects Liability Claim" form.
- During the defects liability period, the customer or operator of the KLEMM Bohrtechnik equipment agrees to perform all maintenance in accordance with the servicing schedule in the instruction manual.
- Any work (maintenance, repairs, etc.) performed on the equipment must be recorded in the maintenance and repair log provided with each piece of equipment.

Exclusions from defects liability:

- Improper use or operation (misuse) of the equipment.
- Failure to adequately maintain or service the equipment, resulting in malfunctions and damage.
- Repairs that were performed improperly.
- Unauthorized modifications or alterations of the KLEMM Bohrtechnik equipment.
- Intentional damage.
- Damage resulting from operator errors.
- Normal wear and tear on parts.

Note:

Wear parts include drilling tools, Kelly bars, ropes etc. If the customer can prove that the damage was caused by a manufacturing defect, the claim will be handled as a defects liability claim.

A) Liabilities and responsibilities of KLEMM Bohrtechnik

- KLEMM Bohrtechnik will supply the replacement parts required for repairs under defects liability.
- If necessary, KLEMM Bohrtechnik will also provide personnel for performing repairs under defects liability.

Old parts or defective parts that have been replaced will become the property of KLEMM Bohrtechnik. KLEMM Bohrtechnik will then decide whether to return the defective parts to the factory of KLEMM Bohrtechnik in Germany.

- **Returns/deadlines**

When returns are requested, the following deadlines apply to the time from the arrival date of the new parts at the job site in the destination country to the arrival date of the damaged parts in the factory of KLEMM Bohrtechnik in Germany.

- Returns by air freight: 4 weeks
- Returns by sea freight: 4 months

If damaged parts requiring shipment by sea freight are not returned on time because of the situation at the job site, the Customer Service Department must be informed of this no later than six weeks before the deadline.

For returns by air freight, the deadline may not be extended.

If parts are not returned within the agreed period, the unpaid items on the outgoing invoice must be paid by the customer.

B) Liabilities and responsibilities of the customer

- The customer will pay any customs duties levied in the country of destination for parts delivered under defects liability.
- The customer will also be responsible for local transport to the final destination (job site) in the case of a defects liability claim.
- Meticulous compliance with the instruction manual and observance of proper operating procedures for all equipment.
- Performance of necessary maintenance according to the service schedule.
- Comprehensive and proper record-keeping using a maintenance and repair log (Service log).

4 Guarantee

If a guarantee has been granted it expires immediately if:

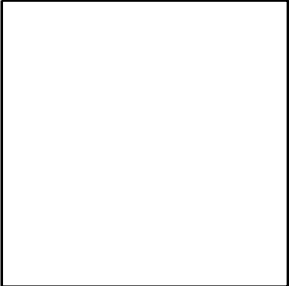
- The equipment is not operated properly and according to its intended use.
- The equipment has not been repaired or maintained in accordance with the prescribed conditions. This also includes the fact that only permitted operating fluid, auxiliary materials, and spare parts may be used.
- The service log has not been properly updated.

5 Type plate on the equipment

This manual applies to the following equipment:

Equipment name:	KR 709-3G
Serial number:	M-24410
Year of manufacture:	12.2018
Certification:	CE

The equipment is identified by the following type plate:

Hersteller manufacturer constructeur	KLEMM Bohrtechnik GmbH 57489 Drolshagen Germany		
Maschine machine machine	Bohrgerät drill rig foreuse		
Typ type type	KR 709-3G		
Seriennummer serial number numéro de série	M-24410		
Baujahr date of constr. année de constr.	12.2018		
Leistung power débit	160	kW	
Elektroanlage electric system système électrique	24 / =	V / Hz	
Masse mass masse	19000	kg	
Vorschub-/Rückzugkraft feed-/retraction force force pousse/retraction	130 / 130	kN	Nächste Sicherheitsprüfung safety check contrôle de sécurité  Made in Germany

6 EC-Declaration of Conformity

Original EG-Konformitätserklärung im Sinne der Maschinenrichtlinie 2006/42/EG (Anhang II A) Original EC-Declaration of Conformity according to European Machinery Directive 2006/42/EC (Annex II A)		KLEMM Bohrtechnik
Hersteller / manufacturer	KLEMM Bohrtechnik GmbH, Wintersohler Str.5 57489 Drolshagen	
Dokumentationsbeauftragter / documentation representative	Jens Mühlhaus Wintersohler Str.5, 57489 Drolshagen	
Maschine / machine	Hydraulisches Bohrgerät / hydraulic drill rig	
Typ / type	KR 709-3G	
Serien-Nr. / serial-no.	M-24410	
Auftrags-Nr. / order-no.	372055629	
Baujahr, -monat / year, month of manufacture	2018.12	
Motorleistung / engine power	160 kW	
Motorenndrehzahl / engine nominal rpm	2000 1/min	
Schallleistungspegel / sound power level		
gemessener Wert / measured value	107 dB(A)	
garantierter Wert / declared value	110 dB(A)	
Konzeption und Bau der Maschine entsprechen folgenden Bestimmungen		
Design and construction of the machine are in accordance with		
Maschinenrichtlinie / Machinery Directive	2006/42/EC	
Outdoor-Noise-Richtlinie / outdoor noise directive	2000/14/EC	
EMV-Richtlinie / EMC-Directive	2014/30/EC	
Druckgeräte-Richtlinie / pressure equipment directive	2014/68/EC	
Richtlinie einfache Druckbehälter / directive simple pressure vessels	2014/29/EC	
Niederspannungs-Richtlinie / low voltage directive	2014/35/EC	
Weitere angewandte harmonisierte europäische Normen		
other applied harmonised european standards		
Sicherheit von Maschinen / safety of machinery	EN ISO 12100	
Bohrgeräte-Sicherheit / drill rigs safety	EN 16228	
Erdbaumaschinen Sicherheit / safety of earth moving machinery	EN 474	
Angewandtes Konformitätsbewertungsverfahren gemäß Richtlinie 2000/14/EG		
conformity assessment procedure according to directive 2000/14 EC		
Interne Fertigungskontrolle nach Artikel 14, Abs. 2 in Verbindung mit Anhang V		
Internal production control according to article 14, item 2 with annex V		
Nationale technische Normen und Spezifikationen		
national technical standards and specifications		
Hinweis:	Punkte 5.02.2.3, 5.15.2, 5.20, 5.23.2, Anhang B und G der EN 16228-1 werden durch Ausführungen gemäß EN ISO 12100 ersetzt. Die Konformitätserklärung ist nur gültig für den Maschinentyp inklusive Spezifikation gemäß Seriennummer und Auftragsnummer. Bei wesentlichen Änderungen an der Maschine wird diese Konformitätserklärung ungültig. Im Zweifelsfall ist der deutsche Wortlaut maßgebend.	
Note:	Articles 5.02.2.3, 5.15.2, 5.20, 5.23.2, Annex B and G of EN 16228-1 are substituted by implementations according to EN ISO 12100. This conformity declaration is only valid for the machine including specification according to serial number and order number. In case of substantial modifications of this machine this declaration becomes invalid. In case of doubt the german text is binding.	
Klemm Bohrtechnik GmbH Wintersohler Str. 5 57489 Drolshagen Deutschland / Germany Tel: +49 (2761) 705 - 0		KLEMM Bohrtechnik KLEMM Bohrtechnik GmbH Wintersohler Str. 5 57489 Drolshagen
		Ort / Place Drolshagen

7 Intended use

7.1 General conditions

Intended and authorized use means use under strict compliance with all instructions in this manual along with any additional instructions or instructions, directions, precautionary measures and prohibitions contained in documents.

The overall contents of this instruction manual pertain and refer exclusively to the equipment including all original equipment and manufacturer-installed options in the condition they were in on the day of delivery to the initial purchaser.

Any modifications made to the equipment, its components or manufacturer-installed options after delivery can compromise the safety of the equipment, whereupon this instruction manual is no longer valid. Use of this equipment after such modification is unauthorized unless under prior written consent from KLEMM Bohrtechnik GmbH as indicated below.

The manufacturer cannot be held liable in any way for any incidents arising from or associated with prohibited and unauthorized use of the equipment, unless such use after modification has been consented to in writing by KLEMM Bohrtechnik GmbH.

Following modification of the equipment, original components or manufacturer-installed options, it may not be used in any way or at any location without written consent from KLEMM Bohrtechnik GmbH or until such consent is issued. Please submit a modification request to KLEMM Bohrtechnik GmbH in order to receive such authorization.

Any use of this equipment other than as authorized and described in this instruction manual shall be considered unauthorized and is hereby expressly prohibited.

The manufacturer shall not be held liable for any injuries or damages of any kind that occur directly or indirectly in any way, shape or form in conjunction with or as a result of unauthorized or not expressly authorized use as described in this instruction manual.

7.2 Equipment-specific conditions

The KLEMM equipment must be used only as directed in DIN EN ISO 12100 (safety of machinery), and as described in the operators manual for drilling operations.

The equipment is only being used as intended for the following work practices:

- Rotation and rotation-percussion drilling
- Double head drilling (rotation / rotation)
- Double head drilling (rotation / rotation-percussion)

Special tasks:

- High pressure injection (HPI)
- Heat probe drillings
- Micro pile drillings
- Exploration drillings
- Drillings for strand anchors or soil nails
- Drillings for freezing boreholes

7.3 Improper use

The equipment may only be used for the activities prescribed in the chapter "Intended use" and approved by the manufacturer.

The following in particular are forbidden:

- Use of the equipment to transport persons.
- Use of the equipment as a transport vehicle.
- Use of the chassis and the kinematics (all positioning elements for positioning the drill mast and attachments) of the equipment as a crane or lifting vehicle.
- Use of the equipment for leveling work.
- The drill rig must not be used as a recovery vehicle for other machines or objects.
- Use of the equipment for moving loads.
- Use of the equipment in explosion-endangered areas.

The use of mounted rope winches is only permissible with vertically aligned and propped drill mast for handling of drill pipes, drilling accessories, and products, which are built into the borehole. Loads and diagonal course of the rope hoist are only permissible in the context of the limitations indicated in the operating instructions.

8 Safety

SAFETY IS ALWAYS TOP PRIORITY!

Read this instruction manual before operating the equipment.

Failure to observe operating instructions, safety regulations, and accident prevention regulations can result in serious injury or death.

Most accidents result from failure to observe basic safety and accident prevention regulations when starting, assembling, operating, or maintaining the equipment.

8.1 Terminology

In this manual, we differentiate between:

- Safety statements = risk of personal injury



- Material damage and environmental damage



- "Tip" = additional and helpful information on using the equipment



8.1.1 Hazard ratings

Safety statements and warning statements for material/environmental damage are organized based on the "SAFE" principle. This means they contain information on the type and source of the hazard, the possible consequences and the prevention of the hazard "Δ". The following hazard ratings apply to safety statements:



indicates a hazardous situation that will result in death or severe, permanent injuries.



indicates a hazardous situation that can result in death or severe, permanent injuries.



indicates a hazardous situation that can result in temporary, moderate or light injuries.

8.2 General Safety

have to be observed in order to avoid/prevent risks associated with handling the equipment in the individual lifecycles.

The equipment-specific safety instructions, which have been collected from the individual chapters of this instruction manual, are presented at the end of this chapter, as an additional supplement. The safety instructions listed in the individual chapters of this instruction manual must also be followed. The safety instructions at the start of a chapter apply equally to the chapter and to its subsections.

Safe operation of the equipment is guaranteed if all the listed safety instructions are followed.

8.2.1 Safety principles

The equipment has been constructed in accordance with the state of the art and the recognized safety regulations and is consequently safe to operate. The equipment's safety is confirmed by the CE mark and by the declaration of conformity or declaration of incorporation, as the case may be.

The equipment may only be operated in a technically impeccable condition and in a safety conscious, risk conscious, and regulations compliant manner. Please follow the instruction manual.

The equipment may only be operated for the purposes and areas of application stipulated in the instruction manual. Any alternative or additional operation is considered contrary to the intended use and is forbidden. Improper use of the equipment can lead to a risk of injury or death for the operator or third parties as well as damage to the equipment or other property. The manufacturer is not responsible for damages caused in this manner. The risk is carried by the operator alone.

All accidents or near accidents that occur while operating the equipment, and which cause or almost cause injury to persons and/or damages in the work environment, must be reported to the manufacturer.

All of the safety instructions in the instruction manual and on the equipment must be observed and adhered to. In addition, all of the applicable rules and regulations in the country of use as well as other compulsory regulations on occupational health and safety, accident prevention, and environmental protection must be complied with.

All work on the equipment must be carried out by qualified and suitably authorized technicians who have received safety training. Access is forbidden to unauthorized persons.

8.2.2 General safety instructions

The instruction manual must always be kept within reach (in the tool compartment or the specially provided container) at the place where the equipment is deployed. The same applies to additional written instructions and safety regulations.

All safety instructions on the equipment must be clear and legible.

Before starting work, check that the equipment is damage-free and in proper working order. If any hazards for persons or changes in the operating behavior are detected, shut the equipment down immediately. Report the incident to the supervisor or operator without delay.

Always comply fully with the maintenance and inspection intervals specified in the instruction manual. Only then is the safety of the equipment guaranteed in the long-term.

No changes may be made to the equipment and its accessories without the manufacturer's approval. This includes any activities that are not permitted or described in the instruction manual and in the supplementary documentation.

- Additions or alterations to the equipment and its accessories.
- The removal/dismantling of components.
- The installation and adjustment of safety equipment, protective equipment, and safety valves.
- Welding of load-bearing parts.
- Making software changes to programmed control systems.

Spare parts and fast wearing parts, together with auxiliary materials and operating fluids, must satisfy the technical requirements defined by the manufacturer.

If it is necessary to use lifting equipment or aerial work platforms for working on the equipment (e.g. for repairs), always implement the applicable safety measures.

It is generally forbidden for persons to stand or work under suspended loads.

If any persons approach the equipment or enter the danger area, the equipment should be shut down immediately. The same applies in emergency situations.

When the equipment is operating, electronic components can emit electromagnetic radiation in the low frequency range or the radio frequency range. This may impair the function of cardiac pacemakers. Turn off all electronic components that are not required, in particular mobile radio units or radiotelephones.

The equipment must not be towed.

The equipment must be inspected at regular intervals by a specially qualified person. The relevant inspection intervals are defined in the instruction manual. Local circumstances may lead to an alteration of the inspection intervals.

Specially qualified persons are persons who, as a result of their technical training and experience, are knowledgeable in the field of special construction machines, and can evaluate the operational safety of this kind of equipment pursuant to the applicable standards and regulations and according to the state of the art.

If the operating company does not have a qualified person, KLEMM Bohrtechnik can be commissioned with the examination.

Examination results must be documented in the service log!

Only suitable tools may be used for performing the various tasks.

Vibrations

The weighted value of the vibrations of the body (feet, seat face) of $0,5\text{m/s}^2$, which can shake the operator during the drilling work, is not exceeded. The value of the hand/the arm vibrations, which shake the operator during the drilling work, is under $2,5\text{m/s}^2$.

8.2.3 Personnel requirements

Anyone assigned the task of operating or servicing the machine must first have read and understood the entire instruction manual. This also applies to persons who have previously worked with or received training for such equipment.

The equipment may only be operated by skilled and authorized personnel who have received safety training. Before the start of all activities, the personnel must be informed of the dangers associated with handling the equipment. The equipment can pose a serious danger of accidents and injury, if it is operated by persons who are not suitably qualified. All personnel are only permitted to perform tasks that correspond to their qualifications.

Refitting, assembly, dismantling, and repair work may only be performed by technically qualified personnel who have received the appropriate safety training. Auxiliary personnel must be specially instructed and assigned to specific tasks.

Personnel being trained, taught, or instructed, along with those working in the context of an apprenticeship, may only work on the system while under the constant supervision of a suitably experienced trainer.

The equipment operator must meet the following minimum requirements:

- He may have to satisfy a minimum age stipulated in the country of use.
- He must be trained to operate the equipment and demonstrate his qualification for the work in accordance with the regulations in the country of use.
- He must perform the tasks he has been assigned reliably.
- He must have passed the legally prescribed health inspections.

Experience shows that persons who also possess the following qualifications are ideally suited to the job of equipment operator.

- Persons who have successfully completed a German training course as a Certified Construction Machine Operator for Earthworks and Foundation Works or an equivalent training course in another country.
- Persons who have successfully participated in KLEMM training courses.
- Persons who have at least one year of construction site experience.
- Persons who are conscious of risks and dangers, particularly in special foundation works.

All persons who are assigned to work on or with the equipment must satisfy the following conditions:

- No physical/mental limitations which temporarily or permanently restrict concentration and judgment (e.g. due to fatigue, illness, or talking on mobile phones).
- Not under the influence of alcohol, drugs, or medication.
- No open, long hair, loose clothing, or jewelry.

Depending on the work being done and the existing work environment, the personnel must wear the following protective equipment:

- Safety vest
- Safety helmet
- Safety shoes
- Hearing protection
- Safety gloves
- Safety glasses
- Protective clothing (e.g. appropriate jacket, trousers, protective shell)
- Breathing equipment

To ensure occupational health and safety, the personnel must be aware of the following knowledge:

- How to find and operate all of the equipment's safety and protective equipment.
- How the equipment's danger areas are demarcated, secured, and labeled.
- How to behave in case of an emergency.
- The location and use of fire extinguishers and first aid boxes.
- How to handle fuels, oils, and other operating fluids and auxiliary materials.
- Measures for occupational health and safety and environmental protection.

Further:

- No fire or naked light is permitted in the immediate vicinity of the equipment.
- No smoking, eating, or drinking is permitted in the immediate vicinity of the equipment.

8.2.4 General responsibilities of the operator

The operator may only put the equipment into operation if it is working properly and safe to operate. He must ensure that, in addition to the safety instructions in the instruction manual, the generally applicable safety and accident prevention regulations and environmental protection requirements of the country of use are observed and adhered to. Additional regulations of this kind might include, for example, first aid measures, fire reporting and fire fighting options, handling of dangerous materials, provision/wearing of personal protective equipment, or traffic regulations. The operator must find out for himself the current version of these regulations.

It is recommended that the operator gets the personnel to confirm in writing that they have taken note of the contents of the instruction manual. It is also recommended to implement training courses which are offered by the manufacturer or officially recognized in the country of use.. Participation in such courses should also be confirmed in writing.

If further instructions, in addition to the instruction manual, are required to ensure accident-free operation, the operator must put these in writing and make them known and accessible to the personnel (e.g. supervision and reporting requirements, observance of specific company requirements regarding the organization of work, operational procedures, or the personnel employed).

The operator is responsible for ensuring that all work on and with the equipment is performed exclusively by appropriately qualified and authorized personnel who have received safety training. The areas of responsibility of the respective personnel must be clearly regulated and defined in writing.

The operator must check the safety-conscious and risk-conscious work of the personnel on a regular basis, taking the instruction manual into account.

The operator must ensure that only those personnel to whom the task has been assigned are working with the equipment or in its danger area. Unauthorized persons have no access to the equipment. The equipment operator, or the personnel he has authorized, has the final responsibility for its accident-free operation.

The operator is responsible for performing a suitable risk evaluation pursuant to the country-specific and/or local laws and regulations. This risk evaluation must take into consideration the working conditions that prevail when the equipment is being operated. The necessary measures for accident-free operation must then be derived from this evaluation. This includes an analysis of the weather conditions and the environmental conditions (e.g. temperature, air humidity and/or areas at risk of contamination) to which the equipment and the personnel are exposed and a specification of how long they should be deployed.

The operator must observe the inspection and maintenance intervals for the various equipment components.

In accordance to the operating safety regulations "BetrSichV" (valid in Germany) the operator must plan the intervals for a safety examination by a qualified person. The examination must be carried out and the examination results must be documented in the service log!

8.2.5 Danger area and safety distance

The danger area is the space around the equipment in which persons could be injured by workrelated movements of the equipment or its work fittings, attachments, and accessories or by unpredictable falling objects. The specific danger area and safety distance for the device are defined in the chapter "Danger zones of the drill rig" from page 92. Always observe and comply with the following safety instructions in reference to the danger area and the safety distance:



Danger of accident!

Standing or working in the danger area while the equipment is being operated can result in accidents and thereby in serious or fatal injuries, such as persons getting hit or crushed.

- Δ All persons must be outside the danger area when the equipment is being moved, positioned, or operated. Only when the equipment is at a complete standstill (i.e. no longer moving) is it permitted to enter the danger area.
- Δ Before starting work with auxiliary personnel, definite signals should be agreed between the equipment operator and the auxiliary personnel (e.g. in the form of hand signals). The agreed signals should be put in writing and made known to all participants. If they do not impair concentration, radiotelephones may also be used for communication.
- Δ Auxiliary personnel must wear highly-visibility clothing, e.g., safety vests. The equipment operator must maintain constant visual contact with the auxiliary personnel during the whole time. Do not move the equipment unless there is direct visual contact. In cases of imminent danger, use the horn as an acoustic warning device.

- Δ Before putting the equipment into operation, always make sure that no hazards are caused by starting the equipment. The equipment operator may only work with the equipment when he has ensured that besides the authorized auxiliary personnel there are no other persons in the danger area.
- Δ During all work on and with the equipment, please note that in certain situations it may be necessary to enlarge the danger area. For example, a minor adjustment of operating elements, such as the control levers, mostly leads to a large movement of the corresponding equipment components. Swinging movements of attached loads or equipment components can also necessitate an enlargement of the current safety distance.
- Δ The equipment must have distinctly visible signs on two opposite sides, clearly indicating the prohibition on entering the danger area. Example of the pictogramm on KLEMM equipments:



- Δ If any persons are at risk, the equipment operator must give a warning. Warnings are generally given by acoustic signals (horn sound). If the horn is not a suitable warning sign, for example, when hearing protection is worn, then other signals must be agreed. These must be incorporated in a written instruction, which must be observed by all persons.
- Δ Warning devices integrated in the equipment to provide acoustic and optical warning signals must be in proper working order. Always check for correct functioning before starting work.
- Δ Observe the safety distance from stationary components, structures, scaffolds, and other equipment prescribed in the country of use. When determining the safety distance, take the pivoting radius, fall radius, and the outer contour of the equipment into account. If it is not possible to observe the safety distance, then close off the area between the stationary components and the turning/pivoting radius.

8.2.6 Safety when handling ropes

Please follow all the instructions in the instruction manual and in the optional supplementary document. Moreover, all specifications from ISO 4308-1 + 2 and ISO 4309 as well as all nationally and locally applicable regulations must also be observed.

Ropes are subject to wear and tear and must be inspected on a regular basis. In some circumstances, the conditions of use or the environmental conditions can lead to a modification of inspection and maintenance intervals. Inspection and maintenance intervals must be adjusted accordingly.

To keep wear and tear to a minimum and to increase safety, always adhere to the following safety instructions when handling ropes:



Danger of accident!

Rope changes not carried out by suitably authorized technicians can cause damage to the respective rope and rope breakages. This could result in serious or fatal injuries to persons.

Δ Only allow ropes to be changed by suitably authorized technicians.



Risk of crushing, cutting, entanglement!

If a rope is being moved by a rope drum or rope pulley, persons in the area of the rope drum/rope pulley can be seriously or fatally injured, caught or entangled.

Δ Do not reach between the rope and the rope drum/rope pulley.

Δ Do not touch moving ropes.

Δ When handling ropes always wear the appropriate personal protective equipment.

**Danger of accident!**

If there is too little rope on the rope drum, the rope can become detached from the rope drum. If a rope is of the wrong size or too strongly tensioned it can break. A rope which is incorrectly wound onto a rope drum or unwound off a rope drum can also break. There is also a risk of breaking for ropes that exhibit signs of wear and tear. If a rope breaks, persons may be hit by falling loads and thus seriously or fatally injured.

- Δ It is always forbidden for persons to stand or work beneath suspended loads.
- Δ The rope drum of a rope winch must always contain at least three windings of rope.
- Δ Always wind and unwind ropes evenly and neatly onto or off the rope drum. Always monitor the process of winding or unwinding a rope.
- Δ Every rope used must possess an adequate minimum breaking force. In the case of rope winches, this must be three times greater than the maximum tensile force of the rope drum.
- Δ Never pull ropes diagonally.
- Δ Check that all ropes are in proper working order every day. A worn rope must be replaced immediately with a new one. Immediate replacement is also necessary for ropes which are damaged by a current transfer (e.g. lightning strike). This type of damage is not always externally apparent.
- Δ If a rope is required to have a rope swivel, only use it with the appropriate rope swivel. Only use rope swivels which are in proper working order. Replace defective or damaged rope swivels immediately.
- Δ Only use the ropes specified by KLEMM Bohrtechnik.

**Risk of collision, risk of chaffing!**

Loose ropes can lead to collision injuries and grazing of body parts.

- Δ Always fasten ropes securely and adequately.
- Δ Fasten loose ropes to the equipment using the holders, which are optionally available for this purpose, as specified in the instruction manual.

8.2.7 General information on stability

The stability of the equipment is structurally guaranteed, provided the prescribed conditions are adhered to. See details in chapter 11 "Stability of the drill rig" on page 102.

The stability of the equipment cannot be guaranteed in cases of:

- Overloading of the equipment
- Sinking surface
- Abrupt acceleration or deceleration of components
- Working on a slope
- Extreme weather conditions

Before starting work, it must be checked whether the load-bearing capacity of the surface is adequate for the loads being carried. A working platform with a suitable ground supporting layer must be present. If the surface does not have adequate load-bearing capacity, it is necessary to take suitable supporting and/or load-distributing measures, in order to secure the equipment against sinking or sliding. If this is not possible, do not drive on the surface. The load-bearing capacity of the ground is usually diminished close to the edge of excavations, shafts, pits, and slopes. The equipment must be so far removed that there is no risk of falling.

The respective equipment specification, the configuration of the process fitting, and the respective operating mode (rigging mode, operation, travel mode) affect the stability in different ways. Which is why the specific instructions and measures for stability are precisely defined in the respective chapter 11 "Stability of the drill rig" on page 102.

The following general safety instructions for stability must always be observed and adhered to:

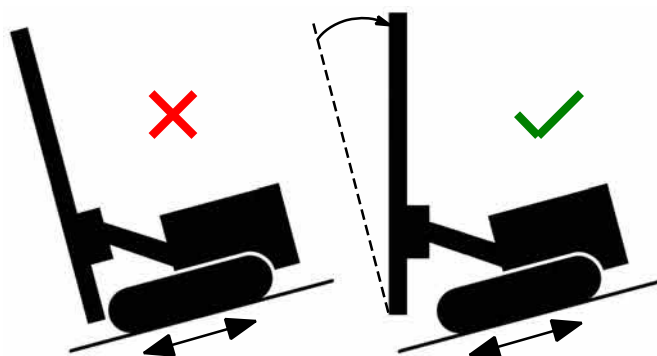


Danger of equipment tipping over!

If there is insufficient stability the equipment can tilt and fall over. This could result in serious or fatal injuries to persons in the vicinity of the equipment.

- Δ Always ensure the stability of the equipment. If there are any doubts as to the stability of the equipment, stop work immediately! If possible, move the equipment to a safe area (e.g. if surface is in danger of caving in) and shut down immediately.
- Δ The limit values for loads, angles, and operating radii, which are prescribed for the different operating modes, are valid for working platforms with a sufficiently stable surface. Never exceed these limit values.
- Δ The values prescribed for loads, angles, and operating radii are not valid in combination or when the process fittings are changed.
- Δ The individual value tables in the chapter "Stability" with the prescribed values for operating the equipment must be kept at the place of deployment and within easy reach of the equipment operator at all times.
- Δ The stability values are only valid for the equipment specification and the process fittings configuration specified in each case. Every change to the equipment specification or the process fittings configuration demands a new stability calculation.

- Δ Only move the equipment on level ground with a sufficiently stable surface. Create a suitable clear space for the travel path.
- Δ Never leave the track of the prepared travel path when driving.
- Δ When driving on slopes or inclines never exceed the maximum permissible tilt angle.
- Δ When travel movements or rotating/pivoting movements are executed by the equipment, keep the equipment's overall center of gravity as low as possible. Work fittings, movable loads, and tools must be lowered as far as possible.
- Δ Driving the equipment crosswise or diagonally to slopes/inclines is prohibited.
- Δ Avoid driving over curbs (e.g. when negotiating ramps). If this is not possible, adapt the manner of driving accordingly.
- Δ Do not attach any additional loads or components to the equipment, which are not permitted or not expressly described in the instruction manual.
- Δ Avoid swinging of loads.
- Δ Ensure an even distribution of the weight of the equipment when traveling on the surface (indicated, in the case of equipment with crawler tracks, by an even penetration of the ground by the crawler tracks).
- Δ Moving the equipment with erected drill mast, especially when moving on ramps:
Ground slope not more than indicated in the stability. To come into a favorable overall center of gravity, the drill mast must be aligned backwards. The upper end of the drill mast must be positioned within the tipping edges of the tracks (see sketch).



8.3 General references to the avoidance of accidents, damages and excessive wear

1 Drill rig

The drill rig has multiplicity kinematic degrees of freedom for positioning of the basic rig and particularly the drill mast.

But not each kinematically possible configuration is meaningful or permissible. This particularly depends on the mounted drill mast, the drilling unit and drilling equipment. Therefore among other things the permitted drilling positions given in the stability calculations, the setting-up sequences and the specific ground pressure as well as all other references in the manual must be observed.

KLEMM Bohrtechnik refers to the fact, that not each theoretically possible drilling position can be described.

If other drilling positions are to be aligned, then this lies in the technical discretion of the operator. Otherwise consultation with KLEMM Bohrtechnik must be taken. The following points must be particularly considered:

1.1 Extreme displacement of the center of gravity

Special attention must be paid when setting-up the drill mast with far out overhanging center of gravity. The center of gravity of the drill mast with its attachments e.g. drill heads and hydr. drifters, drilling equipment and if necessary rod magazines must be placed as near as possible to the ground contact area of the drill rig. The ground contact area of the drill rig is defined by the tipping edges of the crawler tracks.

1.2 Collision

Causes of the multiplicity of kinematic possibilities, the setting-up of the drill rig has to be done with maximum attention, appropriate speed and if necessary with a second instructing person. With inattentive setting-up operations, collisions e.g. between the drill mast and parts of the boom or the basic rig are possible.

1.3 Superposition of kinematic axis

The kinematic degrees of freedom are for example realized by hydraulic cylinders or slewing drive units. The degrees of freedom can be redundant in certain positions, that means for example, that a tilting motion around a certain spatial axle can be achieved by two or more methods. Within the methods, the most favorable method regarding endangerment and damage must always be selected.

2 Extreme environmental condition

If the drill rig is to be operated under extreme or outside the of KLEMM Bohrtechnik specified site conditions, previous clarification with KLEMM Bohrtechnik is necessarily. These are e.g.:

- Extremely low or high temperatures and or humidity
- Special geographical altitudes
- Particularly high dusty condition
- Operations in tunnels or underground

3 Changeable equipment

3.1 Equipment from KLEMM Bohrtechnik

For the drill rigs of KLEMM Bohrtechnik many equipment components, which can be changed or additional mounted are available.

For example these are rotary drill heads, hydr. drifters, rod magazines, drill masts and drill mast extensions, flushing pumps, lubricants and fuels and other components. All combinations of changeable equipment with the drill rig cannot be described. To avoid endangerments and damages, the following points must be strictly observed when self changes of the drill rigs equipment are made:

- permissible stabilities und strengths
- permissible pressures in the hydraulic system
- permissible flow rates in the hydraulic system
- permissible operation modes of hydraulical and electrical components
(e.g. preferred rotation direction of hydraulic motors)
- electrical control- and monitoring functions
- use of safety devices or safety components
- permissible contamination for lubricants and operating materials
- conformity with the European regulation for machines when substantial changes are done (only in the marketing area of the European union).

3.2 Adaptation at or of equipment of other manufacturers

Fundamental the same points as being considered above are to be observed. The adaptations takes place in the discretion of the operator if they are not coordinated with KLEMM Bohrtechnik.

In principle the in the manual and further attached documentation contained safety and warning reference must be observed.
If there is none or a contradictory information to a specified question in the documentation, KLEMM Bohrtechnik must be consulted before operation or conversion.

8.4 Operational safety

8.4.1 General

Safety and protective equipment



Danger of accident!

Missing or not-fully-functional safety and protective equipment can lead to improper operation of the equipment and consequently to accidents. This could result in serious or fatal injuries to persons.

- Δ All safety equipment and protective equipment (e.g. automatic brakes, warning devices, or turnoff devices) must always be easily accessible and must be regularly checked in accordance with the specifications in the instruction manual for completeness, proper fastening and location, and correct functioning.
- Δ Only operate the equipment when all safety equipment and protective equipment are present and fully functional. If any defects are detected, shut the equipment down immediately.
- Δ Have the defect repaired by skilled personnel immediately.
- Δ Any manipulation of the safety equipment and protective equipment is forbidden.

Defects, damages, and/or faults on the equipment



Danger of accident!

Defects, damages, and/or faults affecting the equipment can lead to uncontrollable situations with serious or fatal injuries to persons.

- Δ Before starting work or starting-up the equipment, check the equipment for external signs of damage or defects. If there are any changes to the equipment, including the operational behavior, either refrain from starting-up the equipment or shut it down immediately as the case may be. The same applies if there are doubts as to the operational safety of the equipment, the components, the process fittings, the tools, or the auxiliary devices.
- Δ Following a current transfer to the equipment, check that the equipment's electrical and electronic system is intact and in proper working order.
- Δ Do not enter the equipment's danger area in doubtful operating situations or in the case of malfunctions.
- Δ Have all defects and faults repaired without delay and exclusively by suitably authorized skilled personnel.
- Δ Always secure the equipment against unintentional start-up.
- Δ All operating and control elements in the cab or at the control station must be fully functional.

- Δ Pay attention to displays and fault messages during operation.
- Δ It is forbidden to carry out repairs or maintenance work during operation.

Restoring power supply



Danger of getting crushed, danger of getting pulled in, danger of getting caught!

Unexpected movements of equipment components can occur when the power supply is restored to the equipment (e.g. after EMERGENCY-STOP or power failure). Persons may be severely or fatally crushed, pulled in, or caught by these components.

- Δ Maintain an adequate safety distance when restoring the power supply.

Falling loads



Danger of accident!

Persons in the vicinity of the equipment may be hit by falling loads (e.g. in case of rope breakage) and thus seriously or fatally injured.

- Δ It is always forbidden for persons to stand or work beneath suspended loads.

Storms with high wind speeds



Danger of equipment tipping over!

The equipment can tilt and fall over during storms with high wind speeds. This could result in serious or fatal injuries to persons in the vicinity of the equipment.

- Δ Monitor the local weather, especially the wind conditions (dynamic pressure), in a suitable way (anemometer, wind direction gauge, weather service).
- Δ Observe the maximum permissible wind speed for correct operation of the equipment.
- Δ If the maximum permissible values are exceeded, shut-down the equipment immediately and secure it according to the specifications in the instruction manual.
- Δ Persons in the vicinity of the equipment must leave the danger area immediately.

Driving the equipment



Danger of accident, danger of equipment tipping over!

The equipment can tip over if it is driven in conditions which are not permitted. This could result in serious or fatal injuries to persons.

- Δ The equipment must only be driven from the driver platform or from the intended position.
- Δ Before driving the equipment over long distances, the mast must be placed on the mast support in transport position.
- Δ When driving the equipment, always make sure that the soil condition is adequate to ensure stability.
- Δ The equipment must only be driven within ranges, in which is no risk to cant over! The drivers position of the drill rig is not equipped with a rollover protection system (ROPS).
- Δ Avoid driving in reverse over long distances.
- Δ Before driving into an underpass or tunnel, always check the clearance dimensions of the structural elements.
- Δ Before driving onto an overpass, always check the clearance dimensions of the structural elements and their load bearing capacity.
- Δ Do not execute any additional movements, such as rotating or pivoting movements, while driving.
- Δ It is forbidden to drive the equipment without a banksman.



Danger of falling!

When driving or walking on slippery, uneven, or non-horizontal ground, there is a danger of slipping which can lead to serious or fatal injuries to persons.

- Δ Before driving, clean away snow, ice, and mud from the ground on which you have to drive (e.g. ramps) and from the crawler tracks or wheels.
- Δ To ascend or enter the equipment, only use the steps and platforms specifically provided for that purpose. It is forbidden to climb on open maintenance flaps, for example.
- Δ Steps, platforms, and traffic routes must always be safe to walk on (i.e. no snow, ice, dirt, oil).
- Δ All necessary hand rails and hand grips must be completely mounted.

Lightning strikes



Danger of accident!

Lightning strikes can result in serious injury or death.

- Δ Do not leave the cab if there is an imminent risk of a lightning strike.
- Δ Persons in the vicinity of the equipment must leave the danger area immediately.
- Δ Following a current transfer to the equipment, check that the equipment's electrical and electronic system is intact and in proper working order.

Steps/platforms/handrails



Risk of falling!

Incomplete and/or overloaded steps/platforms/handrails can cause people to fall and thereby receive serious or fatal injuries.

- Δ Before using steps/platforms/handrails, check that they are complete and in proper working order.
- Δ Observe the maximum load of the steps/platforms/handrails being used.
- Δ Step on the equipment except at designated operating platforms is not permitted during the operation!

Started up unintentionally or without authorization



Tipping hazard, danger of accident!

If the equipment is started up unintentionally or without authorization, the equipment can tip over or its components can execute unexpected, uncontrolled movements. This could result in serious or fatal injuries to persons

- Δ During interruptions to work and when work is finished, always secure the equipment against unintentional/unauthorized start-up.
- Δ Always follow the instructions for shutting the equipment down (see page 124).

Concentration of the operation personnel / activation of operating elements



Danger of accident!

A lack of concentration while the equipment is in operation can lead to uncontrollable situations, causing serious or fatal accidents for persons.

- Δ Before using mobile phones or radiotelephones, shut the equipment down and secure against unintentional start-up.
- Δ Only activate operating elements from the operating station.
- Δ Only actuate control levers with hands, only press pedals with feet.

Conditions of visibility / illumination



Danger of accident, risk of falling!

The operation of the equipment must only be done with direct visual contact to the equipment. The danger zone must be monitored by the operator.

Poor visibility during operation of the equipment can lead to serious accidents or collisions with objects. There is also a danger of stumbling over objects and/or falling from the equipment. This could result in serious or fatal injuries to persons.

- Δ The equipment operator must always provide for adequate and optimum lighting in the danger area and working area.
- Δ For the shifting the equipment through darkness, a lighting with a minimum luminous intensity of 10 lux must be given in a distance of 7m from the equipment toward shifting direction.
- Δ The point of drill hole shall be illuminated with a minimum luminous intensity of 100 lux, if necessary from the job site.
- Δ Regularly check the proper functioning of the lighting on and around the equipment.
- Δ If there is strong sunlight, use a suitable glare shield (e.g. special sun blind).
- Δ All tools such as mirrors, cameras, screens, protective glazing must be kept clean at all times. The same applies to all operating and control elements.

Operation in areas with risk of falling objects



Risk of injury!

Working in areas where there is risk of falling objects can lead to serious or fatal accidents for persons.

- Δ The equipment must only be used in areas, where no down-falling items cause danger. Equipment without cabin are not equipped with a protection system FOPS (Falling object protective structures).

Influence of external magnetic fields

**WARNING**

Risk of injury!

Unwanted functions of the equipment can be triggered by the influence of external magnetic fields on the electronic operating and control components and the equipment can be damaged. Unwanted triggered functions can result in serious or fatal injuries to persons.

- Δ Protect electronic operating and control components against external magnetic fields in the immediate area.
- Δ With magnetic objects, a sufficient distance to operating and control components must be maintained.

Refueling the equipment

**CAUTION**

Risk of explosion!

Explosive gases can be generated and fuel can leak when refueling the equipment. Should these gases or the fuel ignite, persons can suffer burns.

- Δ Switch off the drive motor before fueling.
- Δ Smoking and the handling of open fire are forbidden while fueling and in the vicinity of the batteries. Avoid spark formation.

Using the drag hitch

**WARNING**

Danger of accident!

The at the drill rig mounted drag hitch must only be used according the following instructions. A non-approved use of the drag hitch can lead to unexpected, uncontrolled movements of the drill rig and the towed equipment. This can lead to serious or fatal accidents for persons.



For using the drag hitch of KLEMM drill rigs, the following instructions must be observed:

- Δ The use of a KLEMM drill rig as a towing vehicle is forbidden! The drill must only be used in accordance with its intended use.
- Δ The use of the drag hitch for trailer operation is not allowed!
- Δ The drag hitch must only be used for dragging!
Dragging means that a load is pulled, and thus the coupling is subjected to tensile stress only.

- Δ The drag hitch is designed for a max. tensile load of 40kN (4 tons) approved in the longitudinal direction of the drill rig.
- Δ The drag operation is only permitted on solid ground.
- Δ The use of the drag hitch for shunting operations is only allowed on even and solid ground.
- Δ When using the drag hitch is to ensure that the brakes of the drill rig are not overloaded and the drill rig plus the dragged load can be stopped immediately at all times.
- Δ It is forbidden to use the drag hitch for securing the drill rig on slopes.
- Δ It is forbidden to lash the drill rig at the drag hitch.
- Δ Towing the drill rig at the drag hitch is forbidden!

Special instructions for using the drag hitch of KLEMM mini drill rigs
(combination of mini drill rig with power pack)

- Δ KLEMM mini drill rigs (such as KR 702, KR 600, KR 500 and others) are only approved for towing the Power Pack which belongs to the drill rig!

Special instructions for using the drag hitch of KLEMM drill rigs
(excluding mini drill rigs)

- Δ The drag hitch is only to be used to drag building site equipment.
- Δ The dragging is only permitted on even ground.
- Δ Dragging operations must only be done by using a tow-bar or a rigid drawbar.

Energy-carrying interfaces



Danger of accident!

Energy-carrying interfaces are installed at the equipment. Due to improper use of these energy-carrying interfaces persons can be injured seriously or fatal. The following instructions must be adhered without exception.

- Δ Flushing hoses, such as air, grout and mud hoses, shall be secured against freeing themselves, by means of adequate restraints.

Energy-carrying lines (electrically, hydraulically or pneumatically), which are carried to the drill rig or away from the drill rig, must be checked and approved by the operator regarding to its suitability. It is to ensure that these lines are approved for the operating conditions (pressure, volume flow, temperature, current, voltage, etc.). A hazard to the operator of the machine by the failure of this lines must be excluded.

In doubt, appropriate safety devices are to be installed into the system, which shut off the operation at overload and bring the system to a safe operating condition.

To guarantee the safety of these energy-carrying lines, a risk analysis must be carried out by the operator.

The machine system boundaries include the machine and the intended provided interfaces of the drill rig in the original manufacturer's settings. Valve fittings, flushing heads and lines inside of the system boundaries that are used for the supply and discharge of air, water or suspension (for drilling flushing and also for anchor grouting), are designed for the following pressure ranges:

Nominal diameter	Water and suspension	Compressed air
1"	60 bar	30 bar
1,5"	40 bar	30 bar
2"	25 bar	25 bar
3"	30 bar	30 bar

The volume flows have to be dimensioned in accordance with the nominal diameter and the medium in terms unacceptably high dynamic pressures. Because of the drilling process, quantities, energy content and composition of the discharged drilling fluid can change in contrast to the incoming media. Examples: ground water influx to clean air flushing, temperature increase of the drilling fluid in case of heat sources in the soil, changing the composition of chemical active substances in the soil.

The operator of the drill rig is committed to consider these factors for the selection, connection and operating of self installed lines in accordance to the workplace risk assessment.

- Δ If lines are connected by the operator to these energy-carrying interfaces, they must be mechanically fixed. The equipment must not be moved with connected lines. Lines can be torn off, lines can carry out dangerous movements (pulsation, whipping by free discharge of compressed air). Components of the equipment can be torn off and fall off out of the height.

8.4.1.1 Safety when working near over-ground or underground media supplies

The equipment may only be operated within the specifications and environmental conditions prescribed in the instruction manual. Special care is enjoined when working near electricity lines.

Working in the area of utility lines (gas, water, electricity,...)

The contractor is responsible to ascertain if utility or not visible lines are buried on the drilling site. The site's owner is obliged to supply this information. If utility or not visible lines are present their location must be clearly marked.

Plans clearly detailing the location (run and depth) of utility or not visible lines must be kept for reference on the working site. The operator must stop working immediately and inform the site manager if a utility line or its protective cover should be found or damaged. Uncovered utility lines must be secured against swaying or slipping.

Working near overhead electrical lines

The following minimal safety distances must be complied with if working near overhead power lines, unless local or national stipulations require otherwise:

Rated voltage:

up to 1000 V	safety distance = 1 m
above 1kV to 110 kV	safety distance = 3 m
above 110 kV to 220 kV	safety distance = 4 m
above 220 kV to 380 kV	safety distance = 5 m

or if rated voltage unknown safety distance = 5 m

If a min. safety distance can not be respected, the contractor must arrange other safety steps (e.g. cut off or move the electr. line) in accordance with the owner or operator of the electr. lines.

The following general safety information for working near over-ground or underground media supplies must be observed and adhered to.

**DANGER**

Risk of electric shock!

If the equipment comes into contact with overhead or underground electricity lines a current transfer to the equipment occurs. Persons in the immediate vicinity receive an electric shock as well as burns, which can cause serious or fatal injuries.

- Δ Before starting work, ask an authorized person about the prescribed safety distance. Always observe the required safety distance. This also includes the avoidance of swinging loads and/or components in the danger area.
- Δ Before starting work, inform the company responsible for the power supply.
- Δ Consult the power supply company regarding the measures to be taken in case of emergency.
- Δ The danger has passed only when the power supplier gives the all-clear.

**WARNING**

Risk of electric shock, risk of explosion!

Underground lines (e.g. electricity, gas) may be inadvertently damaged during work. Current transfers, explosions, and/or fire may occur and cause an electric shock and/or burns to persons in the immediate vicinity.

- Δ If underground lines are discovered in the working area, stop work immediately and report the incident to the operator.
- Δ In the case of equipment that causes tremors/vibrations, make additional allowance for this potential source of risk and take separate precautionary measures in advance.
- Δ Support or fix exposed lines to prevent them from shifting.
- Δ Maintain a suitable safety distance from sources of danger.
- Δ Do not drive over exposed lines.

**WARNING**

Danger of accident!

In the case of equipment with ropes, there is a danger of rope breakage following a current transfer. Persons may be hit by falling loads and thus seriously or fatally injured.

- Δ After a current transfer, the ropes must be replaced without delay.

8.4.1.2 Safety when working underground or in enclosed spaces

The equipment may only be operated within the specifications and environmental conditions prescribed in the instruction manual. Work carried out underground or in enclosed spaces demands special protective measures.

The following general safety information about working underground or in enclosed spaces must always be observed and adhered to:



Risk of explosion, risk of suffocation!

When working underground or in enclosed spaces, explosive or poisonous gases can be generated.

Persons could suffer serious or fatal injuries or suffocation.

- Δ When working in a closed room a exhaust gas suction system must be used.
- Δ Workplaces and traffic routes must be adequately ventilated, so that no dangerous substances or exhaust gases can reach the breathable air or the atmosphere.
- Δ Always ensure that ventilation systems are in proper working order.

8.4.1.3 Working on slopes



Danger of accident!

When working or driving with the equipment under not permitted conditions the equipment can fall over or slip. Persons can be injured seriously or fatal. The following instructions must be adhered without exception.

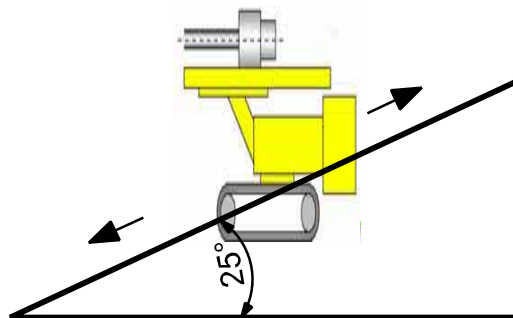
Δ When driving and working on slopes with a slope angle of more than 20°, the drill rig must be equipped and secured with a rope winch (it is forbidden to use free fall winches) to avoid sliding down or rollover of the machine on slopes. The winch must be equipped with a safety brake system. The cable connector point must be designed and tested for dynamical loading forces. Pull force f on third layer of winch:

$$\begin{aligned} f &> 0,50 \text{ for a slope angle of } < 40^\circ \\ f &> 0,40 \text{ for a slope angle of } < 35^\circ \\ f &> 0,30 \text{ for a slope angle of } < 30^\circ \\ f &> 0,20 \text{ for a slope angle of } < 25^\circ \end{aligned}$$

$$f = \frac{\text{winch pulling force}}{\text{weight force of the equipment}}$$

Example:

$$f = \frac{50.000\text{N} (\approx 5\text{t})}{15.000\text{kg} \times 9,81\text{m/s}^2} = 0,34$$



Δ If the pull force f is lesser than shown in the upper sketch, the corresponding winch must not be used for securing the drill rig. A winch with an adequate pull force f according to the upper calculation must be used.

8.4.1.4 Safety references for the feed chain of the drill mast



Danger of accident!

Due to insufficient inspection or improper cleaning or tensioning of the feed chain, persons can be injured seriously or fatal. The following instructions must be adhered without exception.

1. Inspection of the feed chain

The 3,5-time security factor versus rupture of the roller feed chain, according to EN 16228, is only ensured when the feed chain will be regularly inspected.

Principles to the inspection:

Check chains for cracks. Pins and links with wear marks and grooves or mechanical deformations must be replaced. The permitted elongation should not exceed 2%. Measurement must be done in the working area of the grease-free and cleaned feed chain under measuring load. If the permitted elongation is exceeded, the chain is not useable any more and must be replaced.

The measurement should extend to at least 25 links in the working area of the chain and is conveniently carried out as follows:

Fix the total length of 25 links of a new chain (initial dimension / gauge). In this measurement it is to inspect, if the used chain has lengthened by more than half a link length over the initial dimension / gauge. If the initial dimension of the new chain includes only 24½ links of the used chain, the chain must be replaced.

The initial dimension / gauge of the feed chain can be taken out of the technical data.

2. Cleaning the feed chain

The feed chain must always be cleansed of coarse dirt. Build-up of coarse dirt deposits or rocks on the chain can lead to overstretching or rupture of the chain when rolling over the chain deflection of the mast.

3. Tensioning of the feed chain

Tensioning of the feed chain (automatically)

For drill masts with feed gear, the feed chain is generally tensioned automatically by a hydraulic cylinder in the front range of the drill mast. The correct tension of the chain is ensured by the hydraulik system of the equipment.

Tensioning of the feed chain (manually)

To tension the feed chain the slide with drill heads has to be moved to the front position and the drill mast shall be positioned into horizontal.

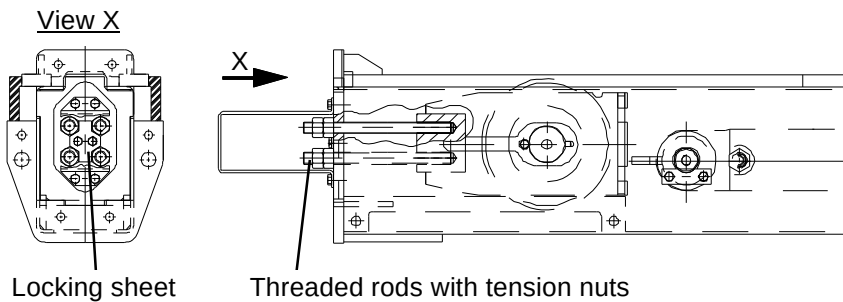
At drill masts with screw tensioning device the chain tension can be adjusted by evenly tightening of the tension nuts.

At drill masts with grease tensioning cylinder, the chain tension can be adjusted by filling or draining of grease into/out of the grease tensioning cylinder which is installed in the front range of the mast.

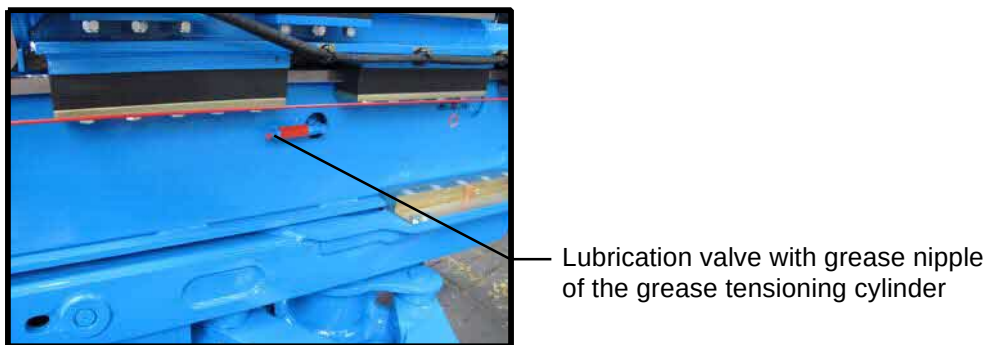
The necessary initial tension is achieved, when the chain is tensioned in a floating condition between the rear chain roller and glide sledge.

In a screw tensioning device a locking sheet avoids loosening by vibrations due to drilling operation and is even mandatory. A frequent check of feed chain tension is necessary to avoid damages at feed cylinder and feed chain.

Sketch drill mast with screw tensioning device



Sketch drill mast with grease tensioning cylinder

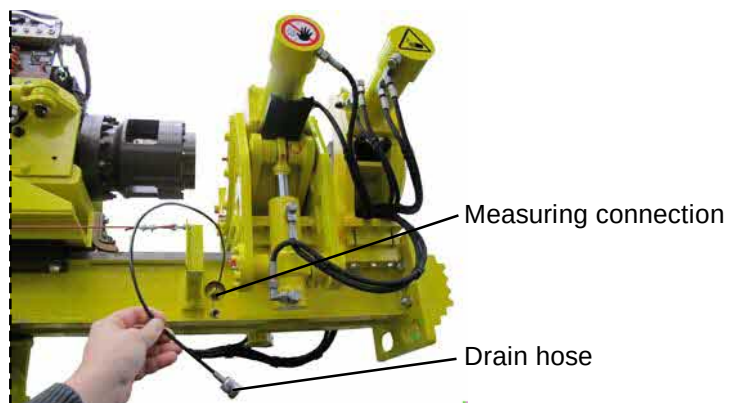


Loosen the pretension of the feed chain

Before starting repair works on the drill mast, the tensioning cylinder must be slacked!

Chain pretensioned hydraulically:

Loosen hydraulic pretension of the feed chain by draining oil out of the hydraulic tensioning cylinder. Connect a drain hose to the measuring connection in the front range of the drill mast (see picture) and drain the oil until the feed chain is slack. Collect the oil in a suitable container. Unscrew the drain hose and close the measuring connection.



Chain pretensioned by a grease tension cylinder:

With grease tensioning cylinders, the grease must be drained by loosening the lubricating valve.

8.4.1.5 Safety references for operation of rope winches on drill masts

1. General



Danger of accident!

Staying of unauthorized personnel in the danger zone when working with the rope winch is forbidden. Non-observance can lead to serious or fatal accidents for persons.

Δ It is generally forbidden for persons to stand or work under suspended loads.



Danger of accident, risk of falling!

An improper use of the rope winch can lead to serious or fatal accidents for persons. The following instructions must be adhered without exception.

Δ The max. load admission area of the winch with drill mast in vertical position is limited to operations at maximum 2,0m distance from the drilling axis line of drill mast (drill hole) in tramming direction. The sidewise load admission area is limited to the tipping edges of the crawler tracks (see sketch on page 54)!

Cause of safety reasons this limitations of the rope winches load admission area must strictly been observed, otherwise accidents and heavy damages on the drill rig can result.

Δ Never misuse the winch cable to trail / traction heavy weights (e.g. bars, barrels, heavy pipes, reinforcement cages) to the drill rig.

The purpose of the winch is to mount accessories for drilling only within the max. load admission area and only with drill mast in vertical position. The drill mast with mounted rope winch is definitely not a crane.

Δ Working with mounted cat head with rope winch on the drill mast is only permitted for vertical drilling operations with mast propped to the soil!

Δ Drilling with drill mast transversely to the driving direction, are only allowed with dismantled cat head and rope winch!

Δ While the winch is used, the drill mast must not be moved.

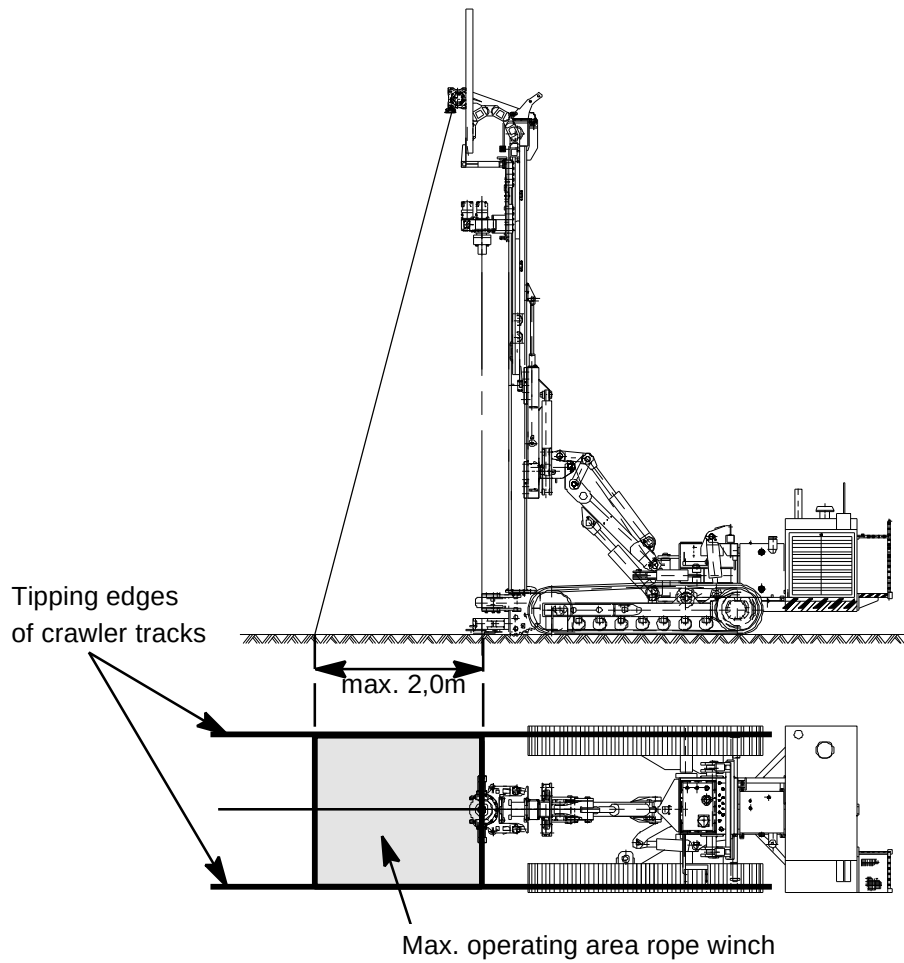
NOTICE

Risk of causing damage to components!

Components of the equipment could be damaged by an improper use of the rope winch.

Δ The on the equipment mounted winch must only be used in accordance with the listed instructions.

Sketch limitation of load admission area for rope winches at drill masts



2. Safety references for operation of collapsible cat heads with rope winches at drill masts

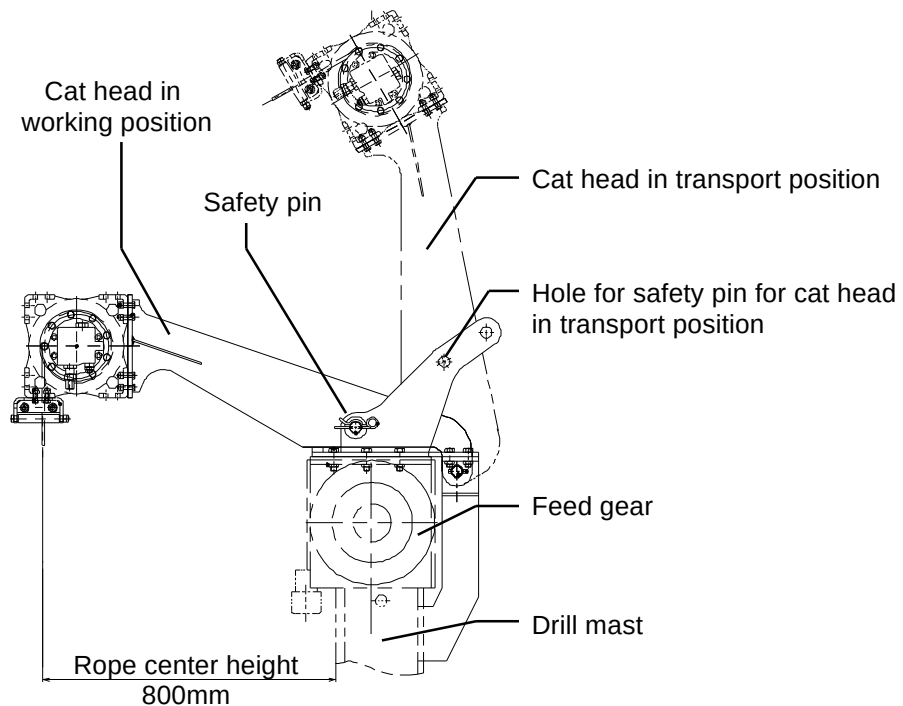
For operation of collapsible cat heads with rope winches the following references must observed in addition to the general references.



Danger of accident!

Non-observance of the following references can lead to serious or fatal accidents for persons.

- Δ Before operating with the rope winch, you must tilt the cat head in working position (see sketch).
- Δ Before transport the equipment, you must tilt the cat head in transport position (see sketch).
- Δ Working with the rope winch with cat head in transport position is forbidden!



3. Safety references for operation of rotatable cat heads with rope winches at drill masts

For operation of rotatable cat heads with rope winches the following references must be observed in addition to the general references.

**WARNING**

Danger of accident!

Non-observance of the following references can lead to serious or fatal accidents for persons.

- Δ The rope winch must be used only for lifting operations in the permitted area (see sketch on page 54).
- Δ The rope winch must be used only when the hydr. drifter or rotary head is switched off.
- Δ When operation the drill rig for anchor drillings, it must be paid attention that the cat head is firmly fixed with the safety bolt. Before moving the drill head unit (hydr. drifter / rotary drill head) backwards, you must tilt the cat head in working position (see pictures).
- Δ Pay attention that the cat head is always fixed in a firm position so that it will not touch the moving hose guide chain.
- Δ For transport of the drill rig, the cat head must be swivelled around 90° out of working position into transport position.



8.4.1.6 Safety references for operation of additional component on the equipment

On Klemm equipment, additional components (e.g. rope winches, welding generators, water pumps, etc.) are mounted. These components are purchased from Klemm Bohrtechnik, and installed according to the installation instructions of the manufacturer. These components usually have an own type plate and an own documentation.



Danger of accident!

Non-observance of the following references can lead to serious or fatal accidents for persons.

NOTICE

Risk of causing damage to components!

Components of the equipment could be damaged by an improper use of additional components.

The following instructions must be adhered without exception.

- Δ The documentation of additional components includes information on the operation and maintenance of the components that must be adhered by the operator. This documentation of the component manufacturer is attached to the documentation of the equipment. From the documentation of the Klemm equipment is referred to these components documentation.

8.4.1.7 Safety instructions to the diesel engine

1. The diesel engine of the drill rig is equipped with a exhaust after treatment system which optionally contains a diesel particle filter (DPF). This diesel particle filter cleans itself in a regular interval or if necessary by a free burning process (regeneration). Exhaust gases with a high temperature can come out of the exhaust pipe while this selfcleaning process.
2. The operator must ensure at all times that fire protection is guaranteed by sufficient distance to adjacent surfaces, substances, etc.
3. The exhaust system must not be modified by the operator or customer. Modification of the exhaust system will lead to voiding of the warranty. In this case KLEMM Bohrtechnik GmbH can not guarantee the adherence to the emission limits.
4. Maintenance and servicing of the exhaust system must only be done by qualified personnel. It must be ensured that the exhaust system is gas-tight after maintenance works.
5. All instructions in the manual of the diesel engine must be abided without exception.
6. The replacing of the diesel particle filter elements must only be done by authorized personnel.



Risk of burning!

During operation of the diesel engine, hot exhaust gases come out of the exhaust system. Persons can get burned on the hot exhaust gases.

Δ Do not stand near the exhaust system.

8.5 Safety information for the general drilling operation

This chapter contains the specific safety information for the general drilling operation as a **ADDITIONAL SUPPLEMENT** to the chapter "General Safety".



Risk of crushing, risk of cutting!

Crushing surfaces and cutting edges are produced, primarily during slewing and tilting of the tool, raising and lowering of the crowd sledge, tilting the mast forwards and backwards, folding the masthead, retracting and extending the mast prop, retracting and extending the clamping cylinder. If persons get between these edges, they can receive serious or fatal injuries

- Δ Maintain adequate safety distance.
- Δ Do not insert any body parts between moving components.



Risk of entanglement!

There is a danger, when drilling out or retracting the drilling tool from the borehole, that persons may become entangled or caught by the drilling tool and thereby seriously or fatally injured.

- Δ Maintain adequate safety distance.
- Δ Do not insert any body parts between moving components.



Risk of injury!

When the drilling tool is drawing out of the borehole, soil, mud and stones can be flung outwards. Persons could be hit and receive serious or fatal injuries.

- Δ Always draw the drilling tool carefully out of the borehole.
- Δ Maintain adequate safety distance.



Risk of injury!

At all works at which persons are in the danger zone of the drilling tool, in particular auger drilling tool, e.g. in the case of cleaning work, persons can be seriously or fatally injured.

- Δ Always stop all movements of the drilling tool before entering the danger zone.
- Δ Secure the equipment against unintentional switching on of any drilling tool movement.



Tipping hazard!

When propping the mast, a high concentration of the load occurs, which can result in the surface caving in. The equipment can then sink on one side into the soil, tilt, and fall over. This could result in serious or fatal injuries to persons in the vicinity of the equipment.

- Δ Before propping the drill mast, the bearing capacity of the subsoil must be ensured.
- Δ If necessary, take additional propping measures and/or weight distribution measures of an appropriate kind.



Danger of accident!

Changing the operating position while the equipment is performing work can cause the equipment to tip over or components to fall down. Persons could be hit and receive serious or fatal injuries.

- Δ Never move the equipment away from the operating position while the equipment and the fittings are performing work.
This applies to all kinematic possibilities for alignment as well as the chassis and optional rotating upper carriage of the equipment.
- Δ Mast before starting work, align the equipment to the required inclination and do not alter this while the work is being performed. Should the position of the Mast be altered by external forces (e.g. by sagging soil), minimum and careful adjustment is permitted.



Danger of equipment tipping over!

Optional, KLEMM Bohrtechnik equipment is fitted with telescopic crawlers. For equipment with telescopic crawlers, working on or with the equipment with the telescoping cylinders of the crawlers retracted can lead to the equipment tipping over. This could result in serious or fatal injuries to persons.

- Δ Extend the telescoping cylinders of the crawlers immediately after unloading the equipment from the transport vehicle and before any further assembly work.
- Δ Only retract the telescoping cylinders of the crawlers immediately before loading the equipment and following dismantling work.

**Risk of injury!**

If the drilling tool is not mounted properly on the fitting, it can fall down or tip over during operation. Persons could be hit and receive serious or fatal injuries.

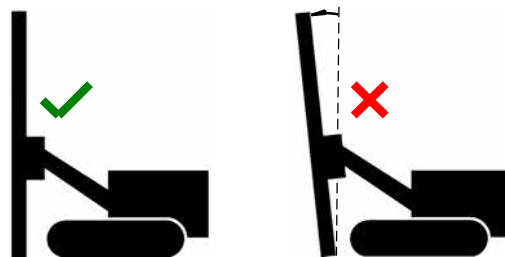
- Δ Always mount the drilling tool using the specially provided connecting elements.
- Δ During the rigging process, never raise the drilling tool higher than necessary.

**Danger of accident!**

If the drill rig is equipped with a rod magazine, drill rods can fall out of the rod magazine if the magazine is not aligned as permitted. Persons could be hit and receive serious or fatal injuries.

- Δ The drill mast with loaded rod magazine must not be aligned forwards out of the vertical mast position (see sketch 1).
- Δ The drilling point of the drill mast with loaded rod magazine must not be aligned upwards out of the horizontal mast position (see sketch 2).

Sketch 1



Sketch 2



NOTICE**Risk of causing damage to components!**

Components of the equipment can be damaged when drill mast is not propped to the soil.

- Δ For drilling operations, the drill mast must always be propped to the drilling point.

Using a spot drilling guide

NOTICE**Risk of causing damage to components!**

Components of the equipment can be damaged when drilling without using a spot drilling guide.

- Δ For drilling operations, a spot drilling guide must always be used. It must be ensured that the drill string does not exceed a certain clearance in the spot drilling guide.

Approximate max. clearance with respect to spot drilling guide:
rod diameter + 10mm

If this approximate distance is reached, the jaws in the spot drilling guide must be replaced with new ones that are compatible with the rod diameter. Note that the manufacturer can accept no warranty liability whatsoever for loss or damage resulting from a failure to observe these setup guidelines.

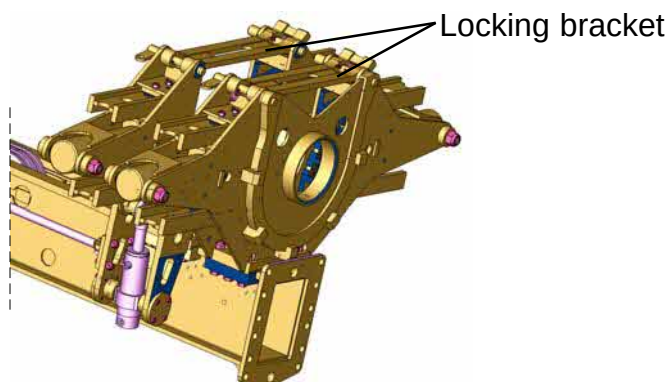
Using a clamping and breaking devices with locking brackets

NOTICE**Risk of causing damage to components!**

Components of the equipment can be damaged by an improper use of the clamping and breaking devices with locking brackets.

The at the equipment mounted clamping and breaking devices with locking brackets must only be used in accordance to the following instructions.

- Δ If clamping- and breaking devices are equipped with locking brackets, these brackets must be closed and locked during operation. The locking brackets are used to take up the clamping forces and to avoid bending of the device housing.

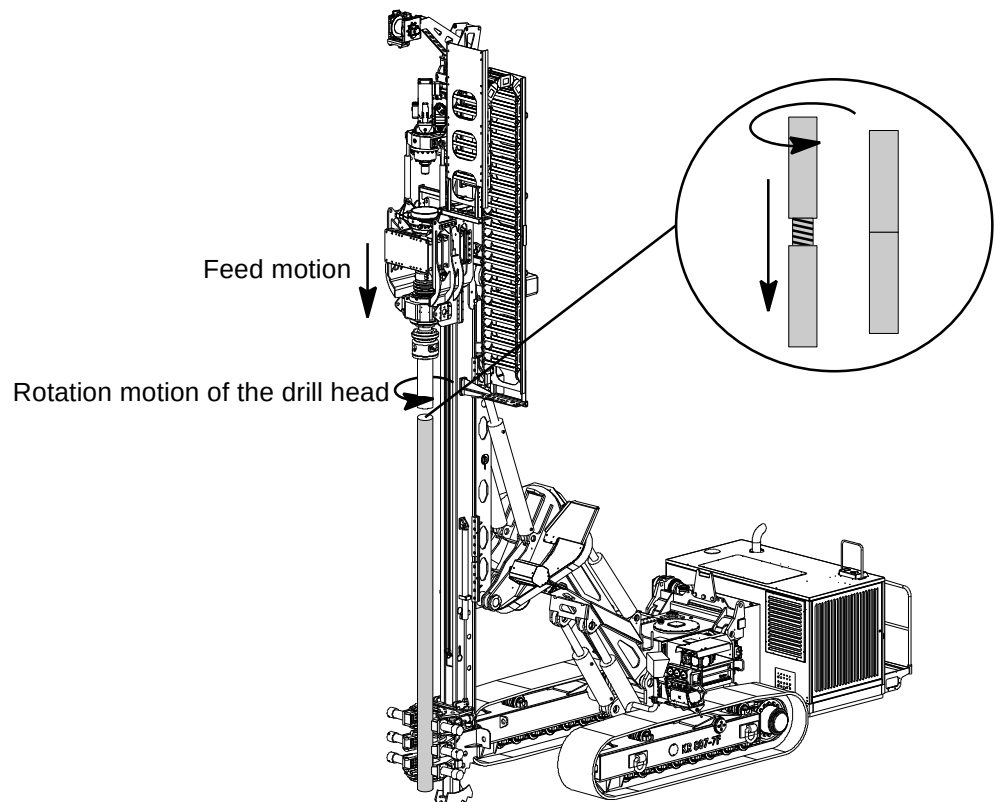


Screwing of drill rods

NOTICE**Risk of causing damage to components!**

Components of the equipment can be damaged by an improper screwing of the drill rods.

- Δ To avoid damage to components of the drill rig, an adequate feed motion must be superimposed on the rotation motion of the drill head (see following sketch). The feed motion must compensate the path, which is forced by the thread pitch during the rotation of the drill rod, as force-free as possible.



Drilling with drilling axis oriented upward (overhead)

NOTICE**Risk of causing damage to components!**

When drilling with drilling axis oriented upward, components of the equipment can be damaged.

Ignoring the following instructions can cause serious damage and lead to loss of warranty and indemnity claims.

Δ When drilling with drilling axis oriented upward and using of flushing media (water, suspension etc.), dirt can get into the gear by flushing medium which flows down the drill string. This can lead to heavy damages to the drill head.

Δ While drilling with hydraulic drifters / rotary heads which have the gear box oil lubricated, gear oil can escape via the filter/breather when the drilling axis oriented upward.

This can cause to an insufficient lubrication and consequently to a failure of the gear unit.

In such cases, please consult KLEMM Bohrtechnik to take appropriate and coordinated measures.

Drilling with down-the-hole-hammer

NOTICE**Risk of causing damage to components!**

Components of the drill rig can be damaged by drilling with a down-the-hole-hammer.

Ignoring the following instructions can cause serious damage and lead to loss of warranty and indemnity claims.

Δ While drilling with down-the-hole-hammer it is mandatory that the driving unit or better its bearing system will not be damaged by the backlashes of the down-the-hole-hammer. This can be ensured by using an additional device such as a Shock Absorber or a Floating Spindle.

Switching rotary drill heads / hydraulic drifters

NOTICE**Risk of causing damage to components!**

Components of the equipment can be damaged by an improper operation. Ignoring the following instructions can cause serious damage and lead to loss of warranty and indemnity claims.

Δ The switching of the drill head for changing the rotation speed and torque must only be done when it is at a standstill. Changing the gear stages under load can lead to malfunction and damages.

8.6 Safety instructions for drill mast slewing



Danger of equipment tipping over!

If there is insufficient stability the equipment can tilt and fall over. This could result in serious or fatal injuries to persons in the vicinity of the equipment.

Δ Instructions to stability of the equipment must be observed.

Δ During drilling operations the cylinder limitation (see picture) must be fixed between the hydr. cylinder and the slewing head. Drilling operations without cylinder limitation are strictly forbidden.

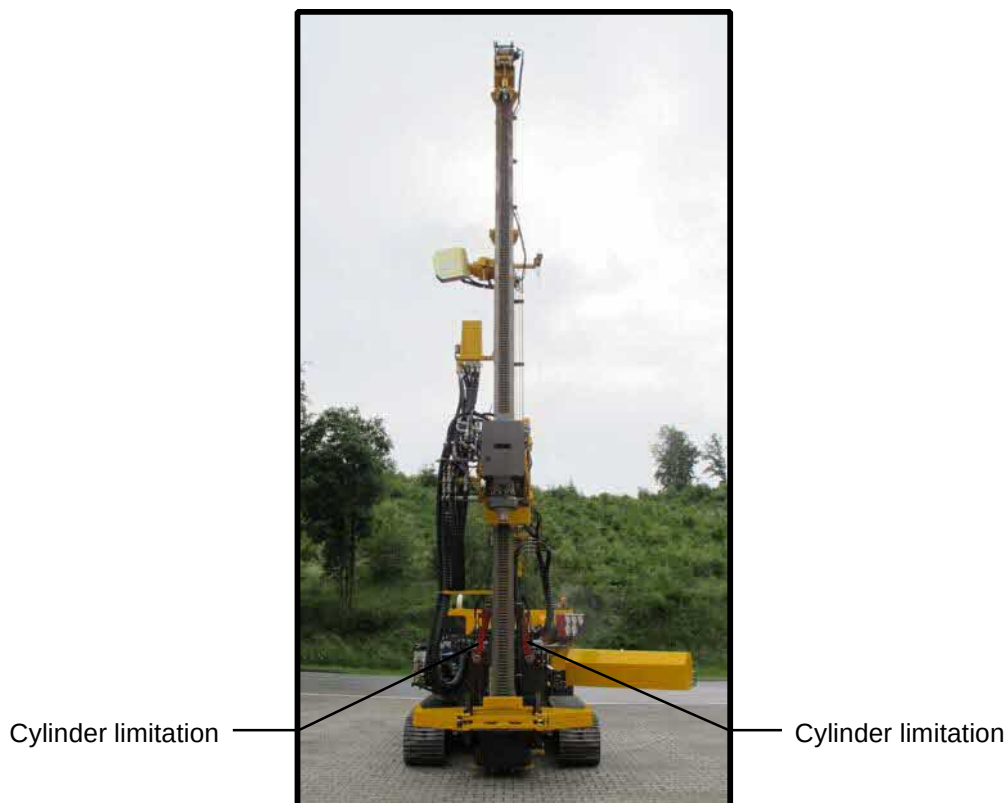
For the following example of drilling equipment, the two cylinders of the function “drill mast slewing” must be limited.

Example for drilling equipment:

Example:

- Drill mast 303 / 9500mm
- Lateral slidable glide slide
- Cat head with rope winch
- Rotary drill head or hydr. drifter

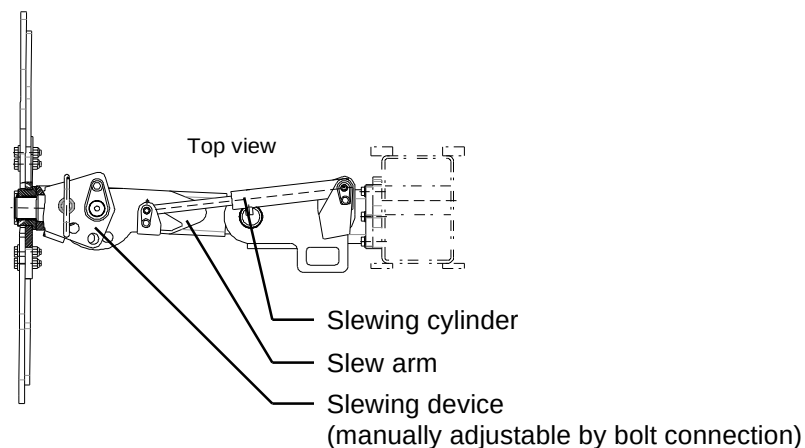
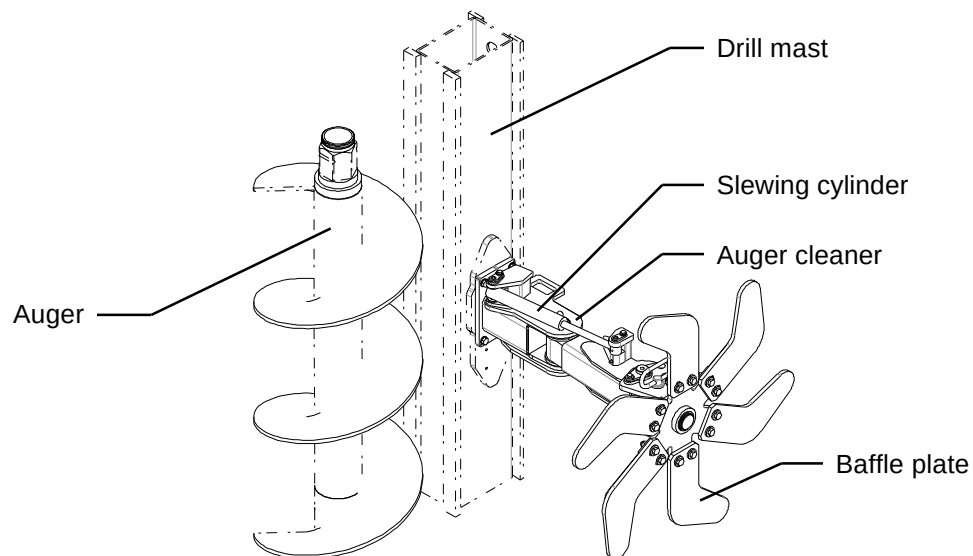
Cylinder limitation $\pm 5^\circ$ (KLEMM part.-no. 0000558578)



8.7 Safety instructions for drilling with a continuous flight auger

General description

All drilling and foundation equipment that is capable of using a continuous flight auger greater than 350 mm outside diameter and with flights wider than 100 mm which can carry material to a height of 10 m or more above ground level shall be provided with an auger cleaning device or connections for an auger cleaning device or other measures to prevent spoil causing injury to personnel at ground level. In this case for equipment of the company Klemm Bohrtechnik, the following shown auger cleaner can be used.



8.7.1 Safety instructions to the auger cleaner

4. Safety instructions for alignment and working with the auger cleaner



Risk of injury!

When drilling out or retracting the drilling tool is drawing out of the borehole, soil, mud and stones can be flung outwards. Persons could be hit and receive serious or fatal injuries.

- Δ When drilling, always slew the auger cleaner to the auger and use it to remove cuttings from the auger.
- Δ The slewing device must only be manually slewed by using the bolt connection when the drill mast is aligned in vertical position.
- Δ Maintain adequate safety distance.
- Δ Discharge spoil without risks to persons, e.g. fitting a shroud or chute that must be attached on-site by the operator to direct material safely to ground level.

NOTICE

Risk of causing damage to components!

Components of the equipment can be damaged by an improper operation. Ignoring the following instructions can cause serious damage and lead to loss of warranty and indemnity claims.

- Δ When setting up the equipment and slewing the auger cleaner, make sure that no components collide with each other.
- Δ Before starting any drilling operation, the auger cleaner must be set up for the diameter of the auger and the emerging cuttings.
- Δ The auger cleaner must only be slewed when the drill mast is aligned in vertical position.

5. Alignment of the auger cleaner

Before starting any drilling operation, the auger cleaner must be set up for the diameter of the auger and the emerging cuttings (see illustration on page 66). The setting can be made as follows:

Slew the slewing device manually to the required auger diameter by using the bolt connection. Slewing the slewing device is only permitted, when the drill mast is aligned in vertical position.

Move the auger cleaner by using the hydraulic slew arm that close to the auger, that the best possible drilling operation and an efficient cleaning performance can be achieved. Cuttings may not be transported during these adjustments.

6. Maintenance of the auger cleaner

The auger cleaner is equipped with exchangeable baffle plates (see illustration on page 66). The wear of the baffle plates depends on the drilling process. The baffle plates must be regularly checked for damage and safe operation and replaced if necessary.

8.7.2 Using a spot drilling guide for drilling with a continuous flight auger



Risk of injury!

Without using a proper guidance, the auger can run away (deviating from the intended direction) during drilling operation. Thereby components can be damaged, flung outwards or fall down. Persons could be hit and receive serious or fatal injuries.

Δ During the rigging process, a spot drilling guide must always be used.

8.7.3 Using a tool handling system for drilling with a continuous flight auger



Risk of injury!

When installing and removing the continuous flight auger, heavy components can fall down uncontrolled. Persons could be hit and receive serious or fatal injuries.

Δ When installing and removing the continuous flight auger, a tool handling system (e.g. a lifting device) is to be used on-site by the operator, which allows a safe transfer of the drilling tool to the drill axis and vice versa.

Δ When installing and removing drilling tool segments (auger segments) make sure, that the part of the drilling tool located in the drilling axis is secured against falling off.

8.8 Safety during assembly/mounting and dismantling/removing

Before starting the assembly or dismantling procedure, the equipment's danger area/working area must be made safe by closing off a sufficiently ample area. Any fittings, components, or tools which are left down must not impede the traffic routes and must be secured by appropriate means against sliding, rolling, falling over, or falling down.

Assembly work and dismantling work must always be performed on horizontal, level ground with a sufficiently stable surface.

All necessary operating processes and functional relationships must have been mastered before taking the first assembly or dismantling steps.

The following general safety information for assembly and dismantling must always be observed and adhered to:



Danger of accident!

Components may fall down or fall over as a result of the unexpected loosening or loss of form-fit, force-fit, and adhesively joined connections. Persons could be hit and receive serious or fatal injuries.

- Δ When mounting components on the equipment, only fix them to the equipment using the appropriate fastening elements.
- Δ Only raise components which are being mounted or removed as far from the ground as absolutely necessary.
- Δ When mounting components on the equipment, check that all screw connections, plug connections, retaining elements, and welding seams are in proper working order, as specified by the instruction manual, and replace with new ones if necessary.



Danger of accident!

The use of unsuitable lifting gear (e.g. lifting device, auxiliary crane) can lead to the tipping over of the lifting gear or the falling of loads. Persons in the vicinity of the equipment could be hit and receive serious or fatal injuries.

- Δ Only use suitable lifting gear with adequate load-bearing capacity.
- Δ If there is an auxiliary winch attached to the equipment, it may only be used for assembly or dismantling work, if this is permitted by the instruction manual.



Risk of falling!

If persons are not properly secured when performing assembly or dismantling work on elevated components, they could fall and receive serious or fatal injuries.

- Δ For assembly or dismantling works, equipment components must be lowered accordingly.
- Δ If works on higher components can not be avoided, the persons must be appropriately secured. Aerial work platforms are to be used.
- Δ Never exceed the maximum permissible load for work platforms and aerial work platforms.
- Δ When performing assembly or dismantling work, always position the equipment at an adequate distance from ground holes, pits, or shafts.



Risk of injury!

Unsecured or loose objects left on or beside the equipment can fall or be flung outwards during operation. Persons in the vicinity of the equipment could be hit and receive serious or fatal injuries.

- Δ During assembly or dismantling, any tools, devices, or work equipment which are left down must be secured against falling, rolling, catapulting, or toppling over.
- Δ When assembly or dismantling is finished, all the tools, devices, and work equipment which have been used must be removed from the equipment.



Risk of crushing, cutting, collision!

Crushing and cutting edges are produced when plug connections and screw connections are loosened from components. Persons who get between these edges can receive serious or fatal injuries.

- Δ To prevent the sinking and/or toppling of components when they are being assembled or dismantled, use the lifting gear to apply sufficient tensile stress to the lifting device attached to these components.
- Δ Always perform assembly or dismantling work safely outside the danger area and with the support of suitable assembly assistants.

**Risk of burning!**

Contact with hot surfaces can cause the burning of body parts.

- Δ Before performing assembly or dismantling work, make sure that hot components of the equipment, such as exhaust pipes, engines, transmission units, hoses, lines (especially cold water lines), and pumps, have cooled down.
- Δ If using a steam-jet device, wear suitable protective equipment. Observe the specifications from the manufacturer of the steam-jet device.

**Risk of injury!**

Escaping compressed air or pressurized fluids (e.g. from high pressure cleaners) can cause injury to body parts.

- Δ If using compressed air, wear suitable personal protective equipment.
- Δ If using a high pressure cleaner, wear suitable personal protective equipment. Observe the specifications from the manufacturer of the high pressure cleaner.

**Risk of injury, risk of cutting!**

Suddenly escaping media (e.g. hydraulic oil) can lead to the cutting of body parts.

- Δ Before assembling or dismantling media-conducting components such as hydraulic hoses, make sure that they are pressure-free.

8.9 Safety when handling suspended loads and during transport

Some equipment or components may only be lifted using special lifting devices (e.g. cross beams). These special lifting devices, when required, are prescribed in the instruction manual. The commissioned transport company is responsible for transporting the equipment and its accessories.

1. General

The following general safety information for transport and for handling suspended loads must always be observed and adhered to:



Danger of accident!

Unsuitable lifting gear or improper loading/unloading can lead to tipping over of the lifting gear, the equipment, or the transport vehicle, or to the falling of loads. Persons in the vicinity of the equipment could be hit and receive serious or fatal injuries.

- Δ It is always forbidden for persons to stand or work beneath suspended loads.
- Δ A banksman must always be present for the entire lifting process and transport process.
- Δ All lifting gears used must be of a suitable and adequate size. Never exceed the lifting gear's permissible load-bearing capacity.
- Δ Only use approved and undamaged lifting gear.
- Δ Only use the specially provided lifting points to attach the lifting device.
- Δ Only detach the lifting device from the component after securing the attached component, or alternatively, before releasing the component, first attach the lifting device fully to the component.
- Δ Always observe the specifications in the instruction manual for lifting and rigging the equipment and its components.
- Δ If there is a load attached, take note of the altered weight distribution and the changed position of the center of gravity.
- Δ Attach loads in such a way that they cannot slide, tilt, or fall down.
- Δ Only lift loads vertically and only as high as necessary. Avoid swinging of the load.
- Δ Only keep loads hanging freely for as long as necessary.
- Δ Never pull loads diagonally.
- Δ Always move loads carefully and never abruptly or too quickly.
- Δ It is forbidden to transport persons with loads.
- Δ Always observe the transport instructions given in the instruction manual.
- Δ For tying down, only use the tying points provided for that purpose.
- Δ Never use tying points or other fastening points as lifting points.

- Δ Before transporting components, they must be suitably secured against unintentional movements.
- Δ Only use suitable lifting gear for transport.

2. Transport of the equipment



Danger of accident!

Because of improper or dirty ramps of the transport vehicle as well as dirty crawlers of the equipment, the equipment can slip during the loading process.

- Δ Before driving the drill rig onto the transport vehicle, the track chains must be cleaned from dirt.
The loading surface of the transport vehicle must be aligned horizontally and must be free of ice, snow and mud. Lay out the loading surface with suitable anti-slip mats.
In order to avoid chutes of the equipment in the case of the loading process onto the truck, ramps must be skid-proof or coated with skid-proof materials. Fix appropriate slings at the designated and accordingly marked lashing points of the equipment and lash it (see chapter 15.2.4 on page 206).



Danger of equipment tipping over!

Optional, KLEMM Bohrtechnik equipment is fitted with telescopic crawlers. At equipment with telescopic crawlers, working on or with the equipment with the telescoping cylinders of the crawlers retracted can lead to the equipment tipping over. This could result in serious or fatal injuries to persons.

- Δ Extend the telescoping cylinders of the crawlers immediately after unloading the equipment from the transport vehicle and before any further works at or with the equipment.
- Δ Only retract the telescoping cylinders of the crawlers immediately before loading the equipment and following dismantling work.
- Δ Small drill rigs of KLEMM Bohrtechnik with telescopic crawlers, which have a track width of less than 2 meters in the retracted state, are to be loaded in the telescoped state.

8.10 Safety during maintenance and environmental protection / waste disposal

For maintenance work, the equipment's danger area must be made safe by closing off a sufficiently ample area. Any fittings, components, or tools which are left down must not impede the traffic routes and must be secured by appropriate means against sliding, rolling, falling over, or falling down.

Maintenance work must always be performed on horizontal and level ground with a sufficiently stable surface.

Spare parts and fast wearing parts, together with auxiliary materials and operating fluids, must satisfy the technical requirements defined by the manufacturer.

8.10.1 General



Danger of accident!

During operation, missing or not-fully-functional safety and protective equipment can lead to serious or fatal injuries to persons, such as crushing, burns, cuts, and collision injuries.

- Δ Only remove safety and protective equipment when the equipment is at a standstill and secured against unauthorized start-up.
- Δ Individual safety and protective equipment may only be removed for specific maintenance tasks, rigging tasks, and repair tasks and only immediately before such tasks. Fully mount the relevant safety and protective equipment immediately after every maintenance task, rigging task, or repair task.
- Δ Whenever a piece of safety or protective equipment is mounted, check that it is working properly.



Tipping hazard, danger of accident!

If the equipment is started up unintentionally or without authorization, the equipment can tip over or its components can execute unexpected, uncontrolled movements. This could result in serious or fatal injuries to persons.

- Δ During interruptions to work and when work is finished, always secure the equipment against unintentional/unauthorized start-up.
- Δ Always follow the instructions for shutting the equipment down (see page 124).



Risk of falling!

If persons are not properly secured during maintenance work on elevated components, they could fall and receive serious or fatal injuries.

- Δ For maintenance works, equipment components must be lowered accordingly.
- Δ For filling hydraulic oil or changing the oil filter, it may be necessary to step on the drill rig. For this purpose, external devices (such as steps) are to be used.
- Δ If works on elevated components are not avoidable, the personnel must be appropriately secured. Suitable aerial work platforms are to be used.
- Δ Never exceed the maximum permissible load for work platforms and aerial work platforms.
- Δ When performing maintenance work, always position the equipment at an adequate distance from ground holes, pits, or shafts.



Risk of injury!

Unsecured or loose objects left on or beside the equipment can fall or be flung outwards during operation. Persons in the vicinity of the equipment could be hit and receive serious or fatal injuries.

- Δ During maintenance work, any tools, devices, or work equipment which are left down must be secured against falling, rolling, catapulting, or toppling over.
- Δ When maintenance work is finished, all the tools, devices, and work equipment which have been used must be removed from the equipment.



Danger of accident!

If maintenance work is not carried out properly and/or on schedule, this can lead to serious or fatal injuries to persons during operation of the equipment.

- Δ Always implement the maintenance tasks and adhere to the intervals prescribed in the instruction manual.
- Δ Before starting the maintenance work, the components in question must be suitably cleaned.
- Δ Components which are reused must be cleaned and inspected for proper condition before mounting them again. Only mount fully-functional components. Replace faulty or worn parts with new ones.

**Danger of accident!**

Components may fall down or fall over as a result of the unexpected loosening or loss of form-fit, force-fit, and adhesively joined connections. Persons could be hit and receive serious or fatal injuries.

- Δ Regularly check all screw connections, plug connections, retaining elements, and welding seams for signs of wear such as rust, cracks, and deformation. See the instruction manual for further information.
- Δ Worn parts must be replaced without delay.
- Δ If the equipment has tipped over or a component has been subjected to an excessive load (e.g. due to an operating error), replace the relevant connections of the component or indeed the entire component with new ones.
- Δ Some connections are subject to regular replacement intervals. Always replace these in accordance with the specifications in the instruction manual.

**Risk of cutting, crushing, entanglement!**

Rotating drive components can cause crushing, entanglement, or shearing of body parts. This could result in serious or fatal injuries to persons.

- Δ All work, especially work in the interior of the equipment, should only be performed with the diesel engine or electric engine switched off.

**Risk of hearing damage!**

Hearing damage can occur when the drive motor is running.

- Δ Persons in the immediate vicinity of the equipment must wear hearing protection.

**Risk of crushing, risk of cutting!**

Crushing and shearing of body parts can occur when opening or closing maintenance flaps on the equipment.

- Δ Only open maintenance flaps using the appropriate handles. Keep body parts outside the swing range of the maintenance flaps.
- Δ Wear the appropriate personal protective equipment.

8.10.2 Safety when handling hydraulic and pneumatic systems

Work on hydraulic and pneumatic equipment may only be performed by persons with special skills and experience in hydraulic and pneumatic systems.

Hydraulic hoses and hydraulic components that possibly must be replaced, must satisfy the technical requirements defined by the manufacturer.

The following general safety information for handling hydraulic and pneumatic systems must always be observed and adhered to:



Risk of injury!

When working on hydraulic and pneumatic components, an escape of pressurized media can occur. This can result in persons being seriously injured by burning, scalding, or cutting.

- Δ Regularly check all hydraulic and pneumatic components for leakages and exterior signs of damage, such as leaks. See to it that damages and defects are repaired without delay.
- Δ Before starting repair work or assembly/dismantling work, discharge the pressure from the hydraulic or pneumatic system.
- Δ When handling pressure tanks, in particular, always observe the country-specific or local laws, regulations, guidelines, and standards.
- Δ Only have the pressure tanks inspected by specially trained persons and serviced by suitably authorized technicians. (also see instructions on page 79).
- Δ Do not touch leaking media. Keep a safe distance. Oil, for example, can reach temperatures of up to 100°C (212°F)
- Δ Wear the appropriate personal protective equipment.
- Δ The method of storing hoses as well as the period of storage and period of use for hoses depends on the operator's requirements. See the instruction manual for further information.
- Δ Changes to the operating pressure of hydraulic or pneumatic systems can only be made with the permission of the manufacturer.
- Δ Only use hydraulic and pneumatic components which are approved or prescribed by the manufacturer. Observe the relevant replacement intervals.

Safety requirements for hydraulic lines

1. Markings

a) Hydraulic hoses must carry continuous markings at intervals not greater than 50 cm. These markings must be clearly readable and supply the following data:

- Name of manufacturer
- Type
- Nominal diameter
- Date of manufacture Example : "1 Q 14" = 1st. Quarter 2014

b) Hose lines must carry the following data in durable markings:

- Name of the manufacturer
- Date of manufacture
- max. permissible
dynamic operat. pressure

2. Storage

Hydraulic hoses must be stored tension-free, in a dry and clean environment. Direct sunlight and UV-irradiation must be avoided. Storage time should not exceed four years.

3. Operating hydraulic lines

a) Hose lines must be examined by an authorized person at least once a year. Hose lines must be replaced if damages, embrittlements, deformations, leakages, damage to the armatures etc. are determined by the examination. Hose lines should be treated according to the "Safety rules for hydraulic hoses ZH 1/74" of the professional association and the standard DIN 20066. The storage and using should not exceed 6 years.

b) Hoses which have been operated as part of a hydraulic line must not under any circumstances be reprocessed

4. Inspection

Hydraulic lines must be inspected by qualified personnel to assess their operational safety before the initial start-up, and subsequently at least once every year. Defective and faulty lines must be exchanged immediately.

8.10.3 Safety when handling with accumulators

Pressure tanks have to be checked only by specially qualified persons and have to be maintained by appropriately authorized personnel only.

At KLEMM equipment hydraulic accumulators are mounted:

- at impact mechanism of hydraulic drifters
- at the hydraulic damping device of hydraulic drifters
- as pilot oil control unit



The pilot control accumulator has no approval obligation.
The Nitrogen pre-tension pressure is $p = 15$ bar.

In case of malfunction the accumulator may be changed without special approval.



Risk of injury!

When working on accumulators, an escape of pressurized media can occur.
This can result in persons being seriously injured by around slinging parts

Δ All of the following instructions must be observed for handling with accumulators.

General

KLEMM Bohrtechnik accumulators are in accordance the european regulation 2014/68/EU (Pressure Equipment Directive).

If an accumulator will be detached and repaired the accumulator has to be checked by an authorised person, according to the operational dependability regulations §10 before it's sent back to site.

Nitrogen pre-tension has to be released before air-freighted. This is valid for separate spare part or monted accumulators!

Any works on hydraulic systems or repair works shall be realized in suitable workshops (warehouses) or under clean environmental conditions!

Works at accumulators

Use only original KLEMM Bohrtechnik parts! If not, you'll lose warranty claim!

For ordering spare parts there are adequate part-numbers available in our part lists.
This is also valid for repair works!

Watch the indicated torques for tensioning the screws!

During disassemble - assemble of units, unit parts, seals, watch the installation direction and location!

Do not weld at accumulators for repair purposes!

Part - assembly drawing shall be used for repairs!

During works at open systems (drifter, rotary head) works like oxygen cutting, grinding, welding etc. shall be avoided!

Any mechanical damages, welding, pretensioning etc. are not allowed!

The mounting of precision parts has to be executed carefully, light moving, without jamming and uncontrolled forces!

Before disassembling the accumulator the nitrogen has to be released:

- take off the cap plug.
- unscrew inlet screw carefully for approx. 1 - 1,5 revolutions, until nitrogen escapes (hiss effect). Don't take off the inlet screw completely, until the pressure has been released completely.

Disassemble the accumulator and clean all parts carefully.

Check the parts on damages and change them, eventually the whole accumulator.

After each disassembly of an accumulator a new diaphragm, new screws and seals shall be installed!

Before assembling the accumulator each part has to be cleaned with non explosive and non aggressive cleaner and pressurized air (don't use water, it leads to corrosion)!

Fit diaphragm and seals according to the drawing. Oil the seal edges and watch the assembling position!

Assemble the accumulator according to the drawings.

Fill the accumulator with nitrogen (N₂) only!

Use therefore only the original KLEMM Bohrtechnik accumulator filling device (P/N: 0000678027)!

Watch the specified filling pressure of the accumulator!

Don't inhale nitrogen (N₂)! work only in safe environment!

Assembly of cpl. accumulator

Watch specified screw torques!

All threads at the accumulator have to be free of dust and grease!

Accumulators with support threads have to be glued in with high tensile glue liquid!

Works have to be executed in clean environmental areas!

Hydraulic fittings and hoses have to be tighten properly!

Check the specified filling pressure of the accumulator!

Seals and screws have only beused in accordance to the Klemm parts lists and shall be bought from KLEMM Bohrtechnik only!

Putting into operation

Watch the safety instructions according to any countries law!

Use accumulators only in oil temperature range -10°C to + 80°C!

Accumulators have to be secured versus external forced ruptures!

8.10.4 Safety for welding, torch cutting, and grinding

Welding, torch cutting, and grinding tasks may only be carried out by suitably authorized technicians who have received safety training.

Necessary works of this kind must be carried out only after consultation with KLEMM Bohrtechnik.

The following general safety information for welding, torch cutting, and grinding must always be observed and adhered to:



Danger of accident!

Statically loaded parts which are thermally processed lose their stability and can crack, break, or bend. This could result in serious or fatal injuries to persons.

- Δ All statically loaded parts must be thermally processed only by the manufacturer or by suitably authorized workshops.



Risk of explosion, risk of fire!

Welding, torch cutting, and grinding tasks on the equipment can cause fire or explosions. This could result in serious or fatal injuries to persons.

- Δ Before starting work, clean flammable or explosive substances away from tools and the environment.
- Δ Only perform such tasks in a suitable environment with adequate ventilation.
- Δ Protect or shield all heat-sensitive components, such as hydraulic hoses, from the area being thermally processed.
- Δ Protect persons and the work environment from flying sparks.
- Δ Before performing welding work on the equipment, protect sensitive electronic parts from current transfers from the welding equipment. Always attach the earth terminal of the welding equipment as close as possible to the welding point.

8.10.5 Safety when handling electrical energy

All work on electrical systems or devices may only be performed by a qualified electrician pursuant to the applicable rules of electrical engineering.

Electricians are persons who can assess the work assigned to them and recognize potential risks based on their technical training or several years of work experience, skills and experience, and knowledge of the applicable standards.

Work on electrical systems or devices may also be performed by persons trained in electronics under the direction and supervision of an electrician.

Person trained in electronics are people who have been instructed and, if necessary, taught by an electrician regarding the work they are assigned and the potential risks associated with inappropriate behavior, and who have been instructed about the necessary protective equipment, personal protective equipment, and safety measures.

The operator is responsible for the choice of personnel. In the context of a risk assessment, he must decide whether the person he assigns to the task meets the above mentioned requirements.

The following general safety information for handling electrical energy must always be observed and adhered to:



Risk of electric shock!

Inappropriate work with or on the equipment's electrical systems (particularly high-voltage components) can lead to a current transfer and/or fire. Persons in the immediate vicinity can be seriously or fatally injured by an electric shock and/or burns.

- Δ Personnel must maintain an adequate safety distance from voltage-carrying components (particularly high-voltage components).
- Δ Before starting work on the equipment's electrical systems, particularly before working on any high-voltage components that maybe present, disconnect them from the voltage supply. Check the voltage-free state and ensure it by appropriate means for the duration of the work.
- Δ Wear the appropriate personal protective equipment.
- Δ Due to electromagnetic fields, persons with cardiac pacemakers must not remain within the immediate vicinity of high-voltage components.
- Δ Do not bring any sensitive electronic devices into the immediate vicinity of high-voltage components.
- Δ Poisonous vapors or gases can be produced by voltage-carrying components. Ensure adequate ventilation.
- Δ Should an electrical fire occur, for example due to spark formation, short-circuit, over-voltage etc., keep a fire extinguisher at hand.
- Δ Before starting up the equipment, ensure that all electrical connections and safety equipment are properly installed, connected, and earthed.

- Δ Only use insulated tools for the relevant tasks.
- Δ Any identified defects, such as scorched, damaged, or loose cables and plugs, must be repaired without delay.
- Δ In case of malfunctions shut the equipment down immediately.
- Δ Secure all of the equipment's electrical and electronic components against unauthorized access. Access to these components is only permitted to authorized technicians.
- Δ Do not repair or bypass fuses. Replacement fuses must be of the identical type and rating.

8.10.6 Safety when handling auxiliary materials and operating fluids

Only auxiliary materials and operating fluids which are approved by the manufacturer may be used.

The applicable safety regulations must be observed in regard to the precautionary measures necessitated by the use of auxiliary materials and operating fluids.

The following general safety information for handling auxiliary materials and operating fluids must always be observed and adhered to:



Risk of explosion, risk of fire, risk of suffocation!

Explosive and poisonous gases can be produced when handling auxiliary materials and operating fluids. Persons could suffer serious or fatal injuries or suffocation.

- Δ Ensure adequate ventilation of workplaces.
- Δ Ensure that the extraction system is properly functioning at all times so that no dangerous substances can reach the breathable air or the atmosphere.
- Δ Always ensure that ventilation systems are in proper working order.
- Δ Dangerous auxiliary materials and operating fluids may only be present in a definite, limited supply quantity.
- Δ No fire, naked light, and/or sparks are permitted in the immediate vicinity of auxiliary materials and operating fluids.
- Δ If the auxiliary materials or operating fluids come into contact with the skin or eyes, take appropriate countermeasures and visit the responsible medical specialist without delay.

**CAUTION****Risk of burning, risk of scalding!**

Direct contact with hot auxiliary materials or operating fluids can lead to burning or scalding of body parts.

Δ When handling auxiliary materials and operating fluids always wear the appropriate personal protective equipment.

**CAUTION****Risk of chemical burns, risk of poisoning, risk of eye damage, risk of skin damage!**

Pressure containers, collection containers for fluids, and/or built-in parts (e.g. filters, batteries) can contain dangerous residues, including acids, oils, oil-containing waste, chemical substances, and/or gases.

Δ Wear the appropriate personal protective equipment.

Δ Avoid direct contact with such substances.

Δ Only transport and store such substances in suitable containers.

Δ Seal and label the containers appropriately.

8.10.7 Safety in case of contamination risk

When working in contaminated areas, the operator must first take the appropriate preventive and precautionary measures.

The following general safety information for working in contaminated areas must always be observed and adhered to:

**WARNING****Risk of injury!**

When working in contaminated areas or on contaminated equipment components, serious or fatal injuries can occur. Persons can be poisoned or contaminated.

Δ Only perform absolutely necessary work in contaminated areas.

Δ Shield the workplace from the contaminated environment.

Δ Wear the appropriate personal protective equipment.

Δ Before starting assembly and dismantling work or maintenance and repair work, find out to what extent and with what harmful substances the equipment or components have been contaminated.

8.10.8 Safety when cleaning the equipment

NOTICE**Risk of causing damage to components!**

Components of the equipment could be damaged by an improper cleaning of the equipment.

- Δ For cleaning the equipment, the following instructions must be adhered without exception.

Do not use cleaning agents with solvent or degreasing substances. Do not use aggressive chemical cleaning agents, e.g. concrete remover. This can spoil the paint work and chromed parts. Do not direct the pressure washer onto electric components and seals.

During cleaning the equipment by water or steam jet, electrical / electronic construction units, e.g. oil pressure switch (sensor), electronic controllers, electronic control members etc., must not be exposed to a direct jet stream. Otherwise penetrating humidity can lead to contact corrosion and to the loss of measuring -/ and control functions. E.g. oil pressure switches cannot be waterproof cause of the necessary diaphragm ventilation; therefore caution when hosing down.

If plugs are nevertheless inadvertent cleaned with a jet steam, the plug connection is to be opened, to dry with compressed air and to spray with contact spray.

Cleaning of KLEMM Bohrtechnik drill heads

NOTICE**Risk of causing damage to components!**

When drilling drill heads are subject to heavy soiling. KLEMM Bohrtechnik drill heads are equipped with gaskets, that seal the inside of the gear to rotating components of drill head. Components of the equipment can be heavily damaged by improper or neglected cleaning. Ignoring the following instructions can cause serious damage and lead to loss of warranty and indemnity claims.

- Δ It is to ensure, that gaskets of drill heads that seals the inside of the gear to rotating components are always kept clean. The sealing effect must always be maintained. In doubtful condition of the gaskets a service must be performed.
- Δ Gaskets of drill heads must not be cleaned by a strong jet of a high pressure cleaner. Dirt could penetrate into the interior of the gear and damage the drill head strongly.

8.11 Safety and protective equipment

8.11.1 EMERGENCY-STOP

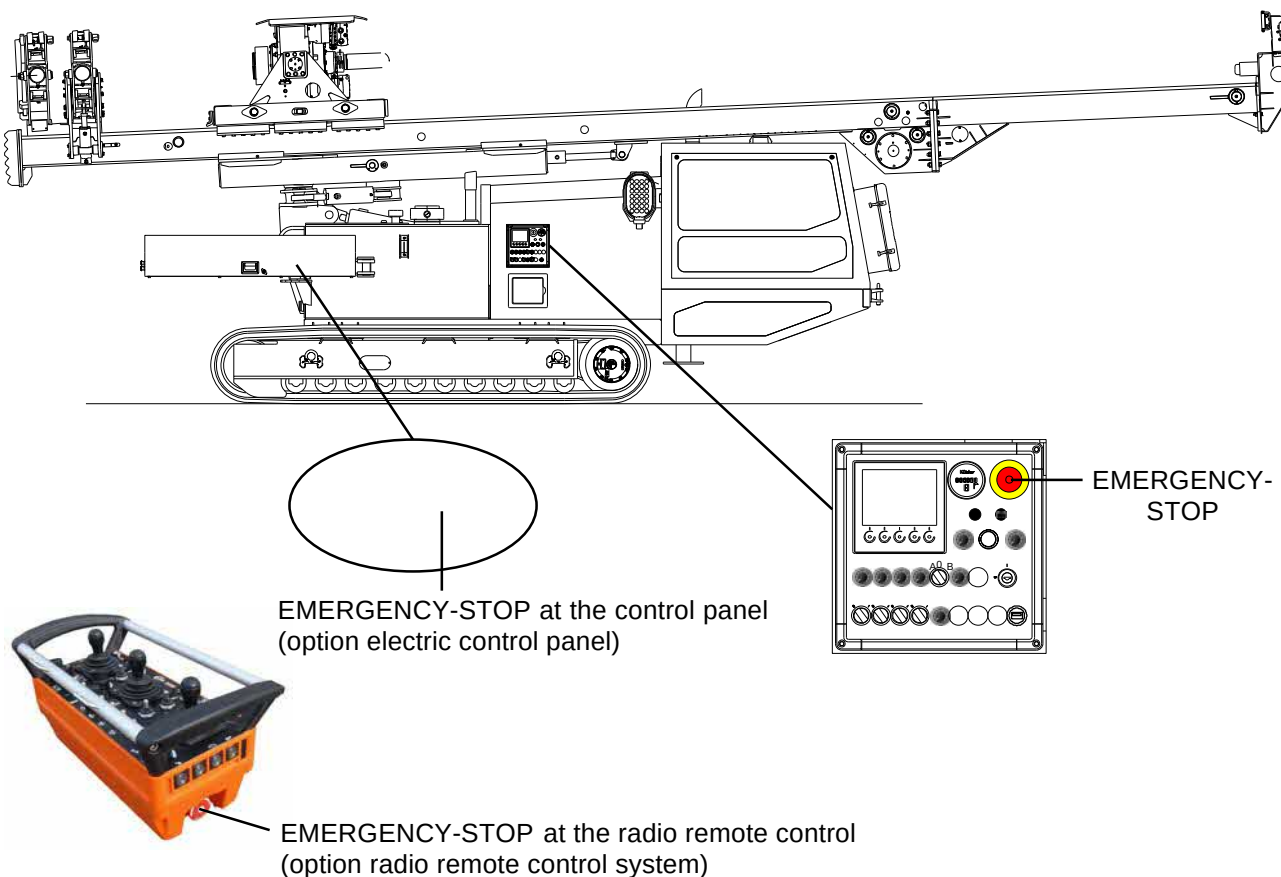
NOTICE

Risk of causing damage to components!

The EMERGENCY-STOP is conceived for an immediate shutdown of the equipment in case of emergency. In this case, the components of the equipment are loaded more heavily than in normal operation. With regular shutdown of the equipment with the EMERGENCY OFF, components of the equipment may be damaged.

Δ All EMERGENCY-STOP installations must only be used in emergencies.

The following figure shows the number and the positions of the EMERGENCY-STOP installations which are installed at the equipment.



Initial position:

In case of emergency

Press the relevant EMERGENCY-STOP.

- All of the equipment's functions are shut down.
- Diesel engine shuts down.

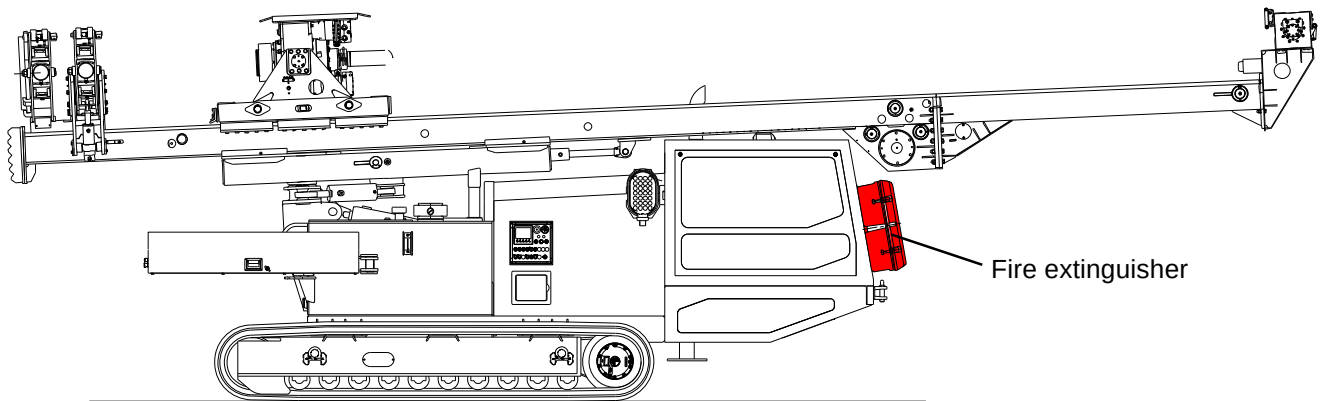
Unlock the relevant EMERGENCY-STOP switch before restarting the diesel engine:

Pull the relevant EMERGENCY-STOP switch.

- EMERGENCY-STOP is unlocked.

8.11.2 Fire extinguishers

The following figure shows the number and position of the fire extinguishers on the equipment.



Read the operating instructions on the fire extinguisher at regular intervals, to ensure that you can operate it correctly in case of fire.

8.11.3 Safety device for the rotation and feed functions (Safety system)

Drill rigs with feed mast where there is the danger that persons can be caught and injured by rotating parts must be equipped with an additional safety device. This safety system must be located in the immediate danger area i.e. the area where the rotating drill string which can be reached into by a person.

The additional safety device works as follows: Positioned in the immediate danger area there are one or more contact ropes. These contact ropes are held under tension by spring loaded electrical switches. By actuating the contact rope the electrical switch is pulled into the switching position and the drilling functions are switched off.

The drilling operation can only be activated again by an active reset by the operator:

Electric switch of the contact ropes in zero position

Controls of the drilling functions in zero position

Press the reset key

8.11.3.1 Start-up and functional test of the safety device for the rotation and feed functions



WARNING

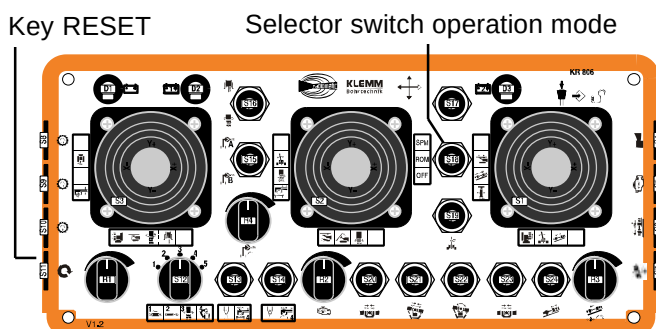
Danger of accident!

Missing or not-fully-functional safety and protective equipment can lead to improper operation of the equipment and consequently to accidents. This could result in serious or fatal injuries to persons.

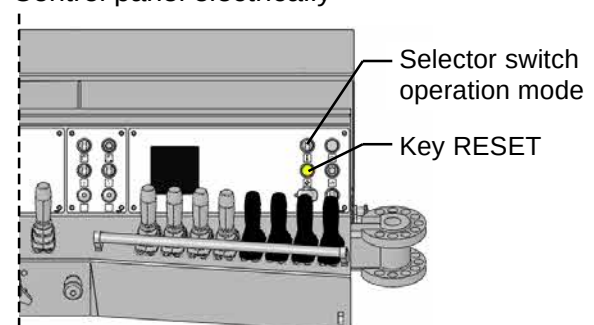
- Δ Before each setup work and drilling operation, the safety device must be checked for completeness, proper fastening and location, and correct functioning.
- Δ Only operate the equipment when the safety device is present and fully functional. If any defects are detected, shut the equipment down immediately.
- Δ Have the defect repaired by skilled personnel immediately.
- Δ Any manipulation of the safety device is forbidden.

Operation elements of the safety device at the control panel

Remote control console

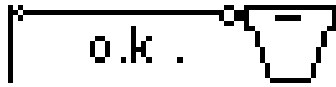


Control panel electrically



Startup of the safety device for rotation and feed functions

1. When the engine is running, the following symbol must be indicated in the display::



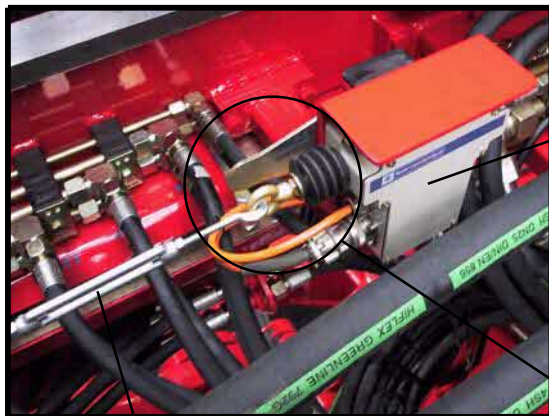
Device is in working order. To activate the drilling functions, press RESET key briefly.

2. If the following symbol is indicated in the display of the engine monitoring box, the safety rope tension of the safety device is not correct or the rope is torn.
The safety rope is to be retightened by using the rope tensioning device.
The front edge of the eyebolt of the safety pull-switch must be on the same height with the front edge of the adjusting plate (see picture below).



3. Press RESET key to activate the safety device.

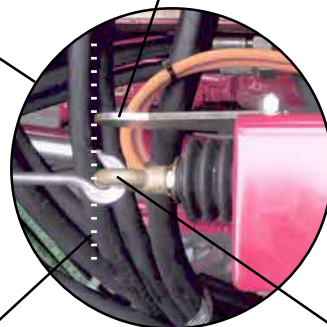
Safety pull-switch on drill mast



Safety pull-switch

Safety rope with
tension adjuster

Adjusting plate



Setting line of
rope tension

Eyebolt

Functional test of the safety device for rotation and feed functions

1. Set rotary head control lever to "Rotation". Rotation must stop immediately, if one of the safety wires is touched.
2. Press RESET key to return to the operating mode.

8.11.4 Safety guard as safety device mounted on the drill mast of the drill rig

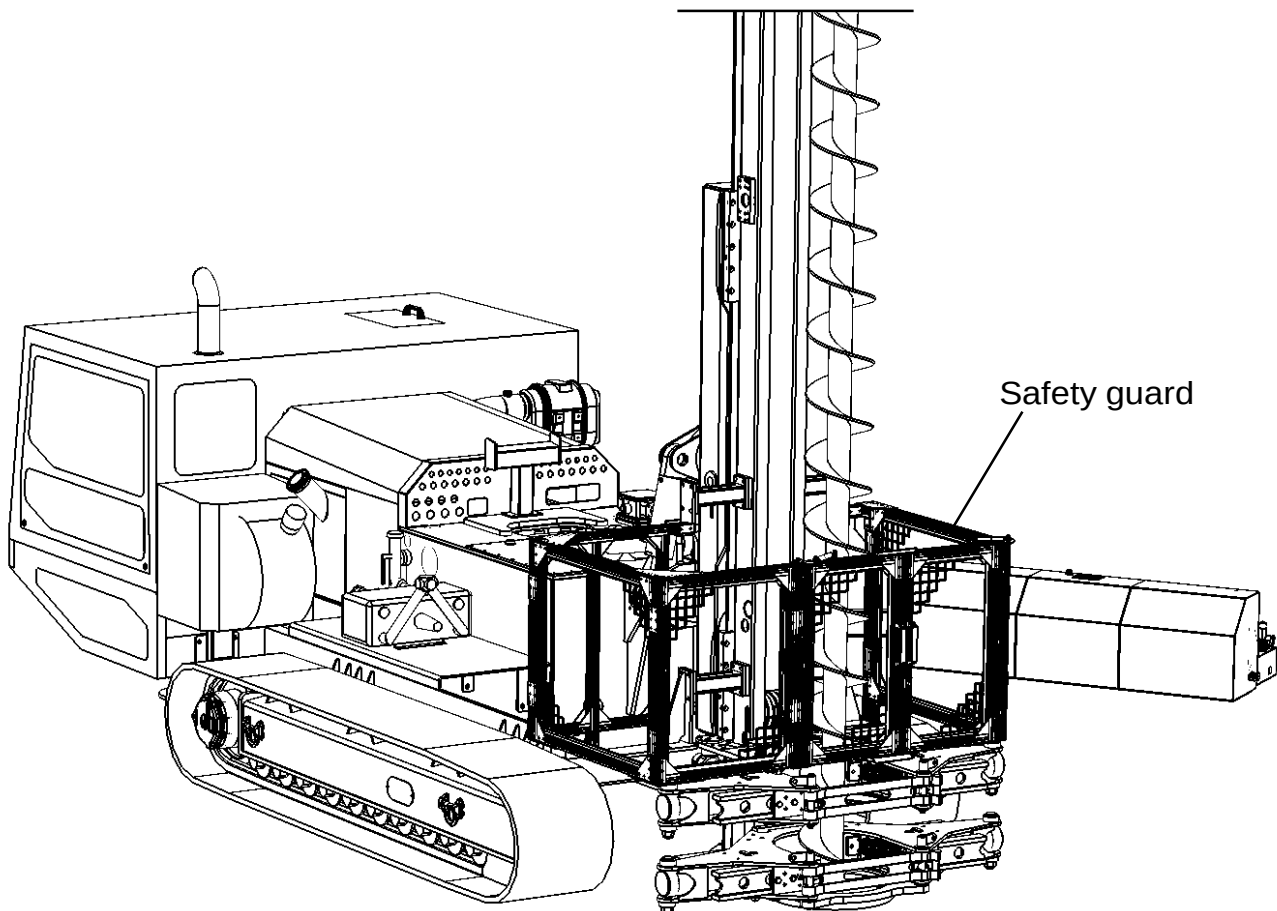
The drill rig is equipped with a safety device for the rotation and feed functions (Safety system), which is prescribed in the norm "Drill-rig safety" EN 16228. As safety device for vertically drilling operations, the drill mast must be equipped with a safety guard. The safety guard is mounted in the front section of the drill mast and consists basically of a steel frame, two laterally fixed lattice elements and two swing doors with a locking.



The drilling functions "rotation" and "feed" are only released when the safety device for the rotation and feed functions (safety system with contact ropes) is activated and the safety guard is in closed and locked condition!



If collisions with the right contact rope of the safety system while shifting the drill head unit occur cause of the mounted safety guard, this right contact rope can be dispensed with in this particular case. The left contact rope of the safety system must always remain fully functional on the drill mast. If the equipment is operated without the safety guard, both contact ropes of the safety system must be fully functional mounted to the drill mast.



Drill rig KR 709-3G with mounted safety guard

9 Danger zones of the drill rig

The following danger zones of the drill rig are arranged depending upon activity into the zones A-F.

Only persons who are trained and told to do the corresponding job are allowed to be in the danger zones. These persons are:

Drill rig driver / operator

Drill rig assistants

mechanics and service personnel

Legend to the following representations of the danger zones:

H = Height of the erected drill mast

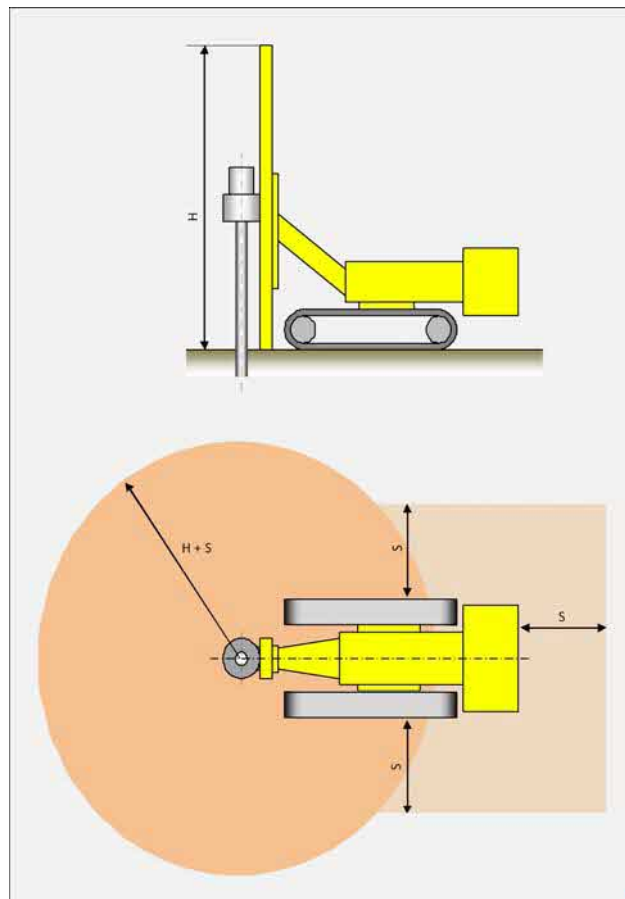
S = Safety clearance: half machine width

B = Radius drilling range: half machine width

K = Working radius of the crane (if crane is mounted)

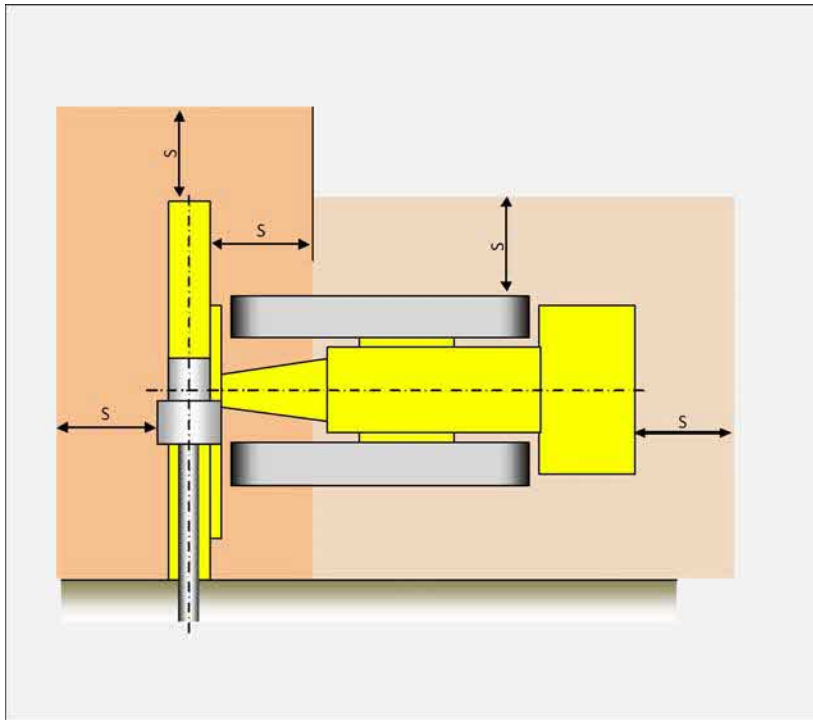
D = Radius of the machine when turning the upper carriage
(if turning the upper carriage is possible)

Danger zone A (Setting up and HPI-drilling with drill mast in vertical position with mounted lattice mast elements)



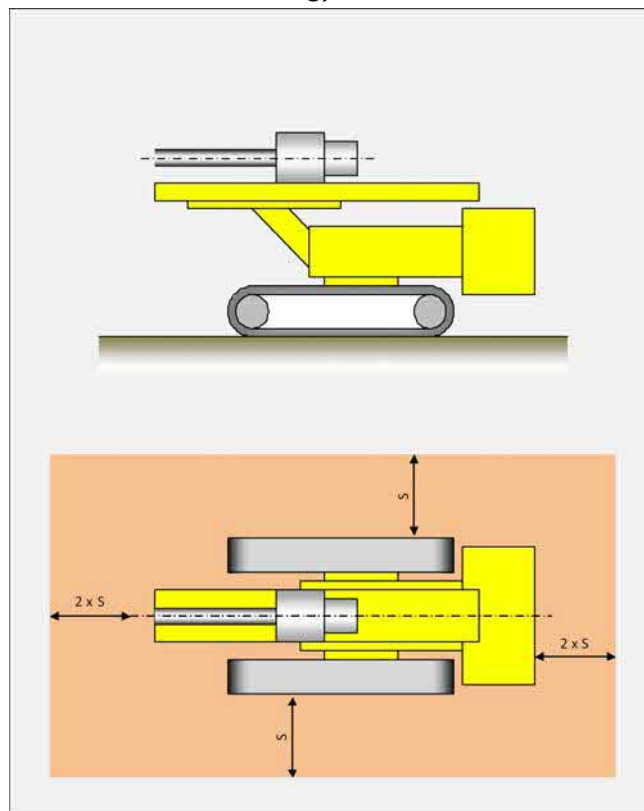
Danger zone B

(Setting up and drilling with drill mast cross to tramming direction / anchor inclination)

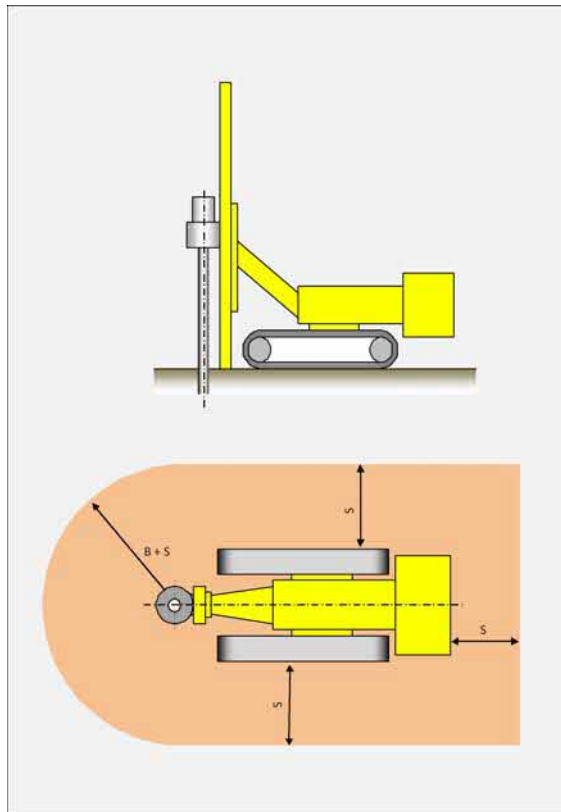


Danger zone C

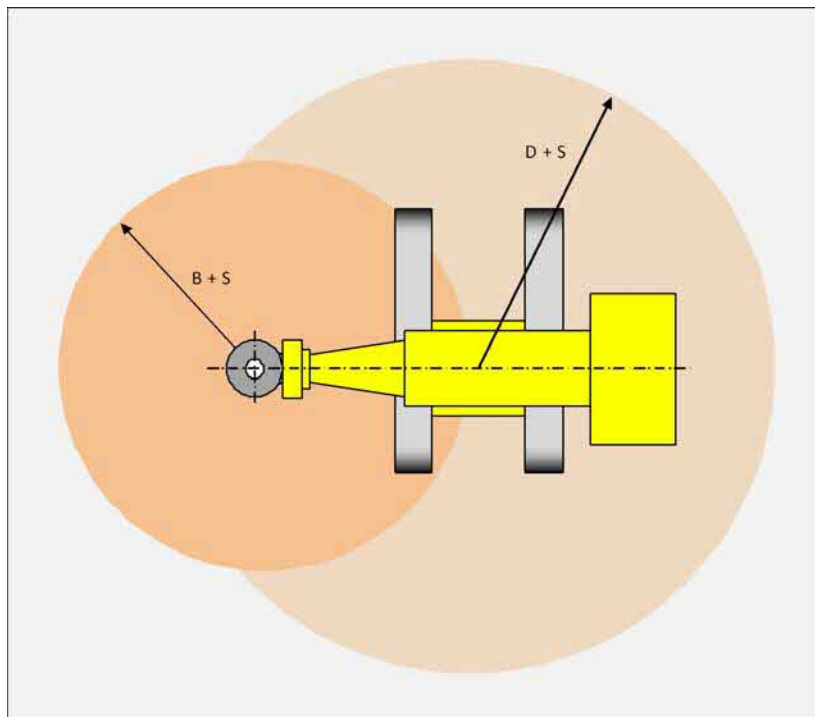
(Moving and maintenance of the drill rig)



Danger zone D (Setting up and drilling with drill mast in vertical position with rigid upper carriage)

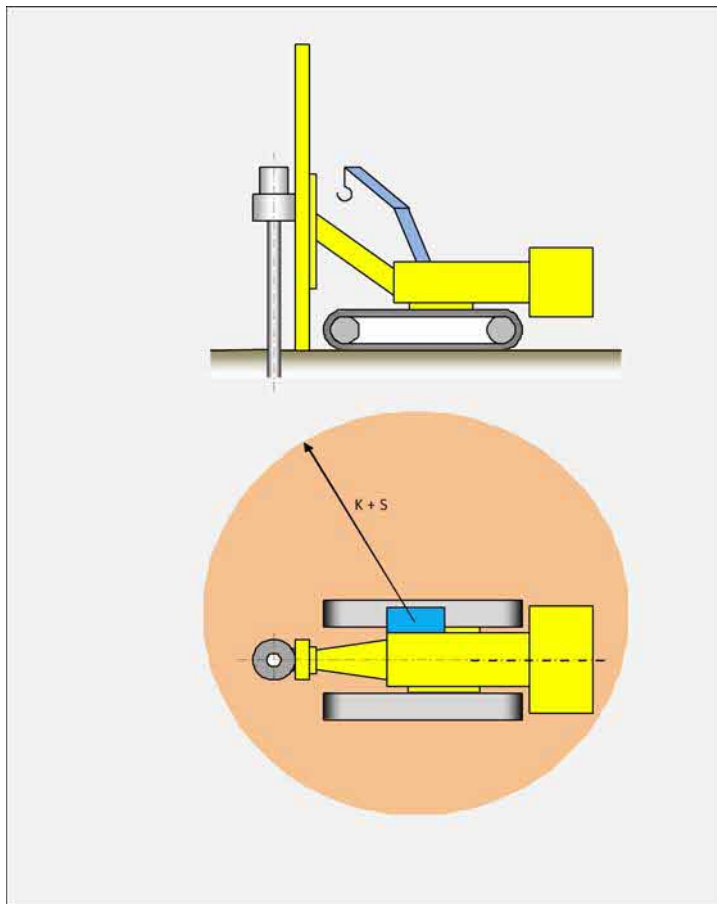


Danger zone E (Setting up and drilling with drill mast in vertical position with turnable upper carriage cross to the tramming direction. Optionally when drill rig is equipped with turnable upper carriage)



Danger zone F

(Working zone of a mounted crane. This danger zone supplements the preceding danger zones optionally)



10 Instruction pictograms at KLEMM equipment

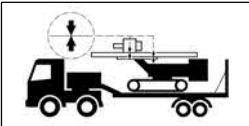
The following table shows a complete overview of all possible instruction pictograms that can be fixed at the equipment.

Nr. / No.	Piktogramm Pictogram	Bedeutung	Meaning	Material Nr. / Material No.
001	 Ø = 100mm	Aufbewahrungsort der Betriebsanleitung	Storage of the operation manual	0000632818
002	 Ø = 50mm	Kopf- und Gehör- schutz benutzen	Use helmet and ear protectors	0000632827
003	 Ø = 100mm	Zutritt für Unbefugte verboten	No admittance without authorization	0000468968
004	 Ø = 100mm	Feuer, offenes Licht und Rauch verboten	Fire, open light and smoking is forbidden	0000468969
005	 B = 100mm	Warnung vor Absturzgefahr	Caution – risk of falling	0000468971
006	 = 100mm	Feuerlöscher	Fire extinguishe	0000991085

Nr. / No.	Piktogramm Pictogram	Bedeutung	Meaning	Material Nr. / Material No.
007	 = 100mm	Kraftstoff nachfüllen	Refill fuel	0000469816
008	 = 30 x 100mm	- Gefahrenstelle - Schlüssel abziehen - Wartungshinweise beachten	- Warning of a danger spot - Pull out ignition key - Follow maintenance instructions	0000469819
009	 B = 100mm	Quetschen zwischen Ober- und Unterwagen	Danger of crushing between upper-carriage and under-carriage	0000469802
010	 Ø = 30mm	Batterietrennschalter	Battery cut-off switch	0000469944
011	 = 30 x 60mm	Betriebsspannung 24V	Operating voltage 24V	0000469947
012	 = 30 x 70mm	- Herausschleudernde Teile - Wartungshinweise beachten	- Ejecting parts - Follow maintenance instructions	0000469948
013	 Ø = 100mm	Anhebeplatz Bau- gruppe	Lifting point machine component	0000469949

Nr. / No.	Piktogramm Pictogram	Bedeutung	Meaning	Material Nr. / Material No.
014	 = 100mm	Verzurrpunkt	Lashing point	0000632836
015	 B = 100mm	Warnung vor Quetschgefahr	Danger of crushing	0000469967
016	 B = 100mm	Betreten der Fläche verboten	Do not step on this area	0000469969
017	 B = 100mm	- Gefahr von herausspritzender Flüssigkeit - Gefahr von herausspritzendem Hydr. Öl	- Danger of spraying Liquid - Danger of spraying hydraulic oil	0000469972
018	 = 100mm	Hydrauliköl nachfüllen	Refill hydraulic oil	0000470003
019	 B = 100mm	Warnung vor dem rotierenden Lüfterflügel	Warning of the rota- ting fan blade	0000470004
020	 B = 100mm	Warnung vor heißer Oberfläche	Warning of hot sur- face	0000470073

Nr. / No.	Piktogramm Pictogram	Bedeutung	Meaning	Material Nr. / Material No.
021	 B = 100mm	Warnung vor Einzugsgefahr	Warning "risk of entanglement"	0000470074
022	 B = 100mm	Warnung vor Handverletzung	Warning of hand injury	0000470076
023	 Ø = 100mm	Anhebepunkt Gesamtmaschine	Lifting point complete machine	0000470078
024	 Ø = 100mm	Gebrauchsanweisung beachten	Follow technical manual	0000470081
025	 = 30 x 70mm	Bohren und Schweißen verboten	Drilling and welding forbidden	0000470113
026	 B = 100mm	Warnung vor schwebender Last	Warning of floating load	0000470115

Nr. / No.	Piktogramm Pictogram	Bedeutung	Meaning	Material Nr. / Material No.
027	 = 300 x 100mm	Gefahren am KDK (KH/KD) (Bohran- lage): – Warnung vor Einzugsgefahr – Warnung vor Handverletzung – Herausschleu- dernde Teile	Danger at drill head unit: – Risk of entanglement” – Warning of hand injury – Ejecting parts	0000470117
028	 Ø = 30mm	Verbotsszeichen: Mit Wasser spritzen verboten	Prohibition sign: Do not spray with water	0000632829
029	 = 100mm	Bedienung Batterietrennschalter 25s	Operation Battery cut-off switch 25s	0000679260
030	 = 50 x 100mm	Transportstellung Lafette / Bohranlage	Transport position drill mast / drill head unit	0000682837
031	 B = 100mm	Warnung vor Verbrennungsgefahr durch starke Hitze (800° C / 1472° F)	Warning of hazard of combustion and strong hotness (800° C / 1472° F)	0000751639
032	 Ø = 100mm	Aufbewahrungsort der Funkfernsteuerung	Storage of the remote control con- sole	0000854398

Nr. / No.	Piktogramm Pictogram	Bedeutung	Meaning	Material Nr. / Material No.
033	 = 100mm	Gefahrzettel Klasse 3 – entzünd- bare Flüssigkeiten	Lable Class 3 hazard – flammable liquids	0000277756
034	 = 100mm	Bedienung Batterietrennschalter 2min	Operation Battery cut-off switch 2min	0000928085
035	 = 100mm	AdBlue nachfüllen	Refill AdBlue	0001092683

11 Stability of the drill rig KR 709-3G

1. General information

Stability means the safety against fall over of the drill rig about its own tipping edges. Tipping edges are the connection lines between the track chain guide rollers and the sprocket wheel in tramming direction. At right angle (90°) to the tramming direction the connection lines between the front bases and the rear bases are further tipping edges. As a result of the above explained undercarriage with parallel tracks it creates a rectangular tipping edge range.

The safeties of stability are described and results by the stability safety angles, which are the max. allowed terrain inclinations in tramming direction and cross to the tramming direction. The minimum permitted stability safety angles according to EN 16228-2 are 10° for tramming the drill rig and 5° for operations under all other circumstances including the influence of wind- and operation forces.

Pay attention that the kinematic possible slewing ranges are restricted by the drill rigs attached equipment and the drill mast set-up in various drilling position as well as the restrictions resulting of the minimum stability safety angles according to EN 16228.

These restrictions are valid for the following important instructions for safe operation of the drill rig on typical sloped work surfaces when drilling and tracking.

2. General safety instructions for stability of drill rig KR 709-3G

Total length of drill string not longer than max. feed length.

Extension of the feed length by using the drill mast displacement cylinder is inadmissible.

Before the drill mast gets aligned in transport position, the drill string must be dismantled and the drill head unit must be shifted forward up to the clamping device / centralizer.

When drilling or pulling the drill string, the drill mast must be propped at the drilling point.

When drilling as well as when using a handling system or a rope winch, both crawler chains of the drill rig must be in full ground contact over the whole area.

Using the rope winch and the cat head only as described in the technical manual (the sidewise load admission area of the rope winch is to be observed).

After the end of the work, the drilling tools must be dismantled, and the drill mast must be aligned in transport position.

When driving the equipment onto a transporting vehicle with a loading ramp slope of more than 19°, the equipment must be loaded in reverse direction (with the engine side first).

Even to all the service purposes and for the installation of drill rods, the maximum permitted machine positions which are specified in the stability, must be observed.

Attaching or removing of additional equipment at the drill mast and to other parts of the drill rig, which affect stability, is only allowed after consultation of Klemm Bohrtechnik.



Danger of equipment tipping over!

Under circumstances, the kinematics of the equipment ensures an alignment of the drill mast, in which the stability of the equipment can no be guaranteed. If there is insufficient stability the equipment can tilt and fall over. This could result in serious or fatal injuries to persons in the vicinity of the equipment.

- Δ Drilling positions that deviate from the permissible positions specified in this chapter "stability" must not be aligned!
- Δ In case of uncertainty about a drilling position can be aligned or not, KLEMM Bohrtechnik must be consulted!

Alignment of the drill mast for vertical drilling operations

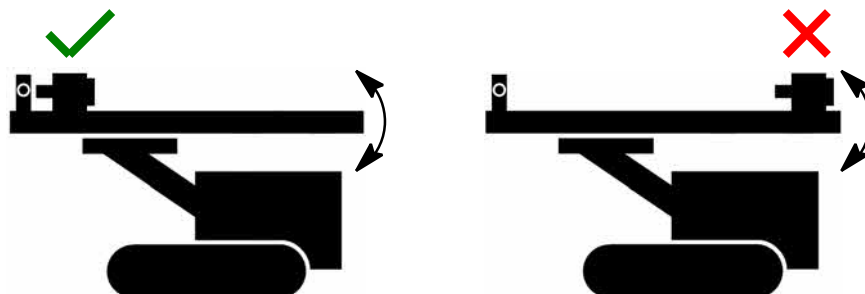


Danger of accident!

An improper alignment of the drill mast can lead to danger for persons and components of the equipment can be damaged.

Non-observance of the the following instructions can lead to serious or fatal accidents for persons.

- Δ The drill mast must only be aligned (erecting or putting down) when no drilling tools are mounted to the drill mast.
- Δ Before erecting or putting down the drill mast, the glide sledge with drill head unit must be positioned in final front position to the clamping device / drilling guide (see sketch).
- Δ Before erecting or putting down the drill mast, the rear propping cylinders must be shifted out to full contact of the propping plates to the ground. When propping the drill rig, the ground contact of the tracks must always be ensured. It is to be guaranteed by the building contractor that the underground exhibits a sufficient load-carrying capacity.
- Δ Drilling accessories may only be installed when the drill mast is set up vertically and propped on the ground.



3. Information about the max. permissible terrain inclinations and ground pressure

The information applies for the following conditions:

According to calculation no.: 0001186975

Weight of basic rig KR 709-3G: approx. 12750kg
 Axles distance - tracks: 2825mm
 Gauge - tracks: 2600mm
 Width of grousers: 600mm
 Total weight of drill mast: approx. 5750kg (including drill head unit, hose guide chain, auger cleaner, without safety guard and without clamping device or similar)
 Weight of drill head unit with glide sledge: .. max. 1360kg (without drill string)
 Weight of drill string in drilling axis: max. 1500kg
 Frame length of drill mast: 13100mm
 Wind force at wind speed: $v = 20\text{m/s}$
 Deceleration forces at: $a = 0,4\text{ m/s}^2$

Glide sledge with drill head unit slided in highest position of the 13100mm long drill mast.

Drilling point B1 with drill mast positioned vertically for vertical drilling operations, see drawing to stability 1019022-00 on page 106	
Restrictions:	
Drill mast inclination max. 3° backwards or forwards (+/-Z) out of vertical position, alignment around D3. Drill mast inclination sidewise not more than max. 3° (+/-X) out of vertical position, alignment around D4.	
Maximum permissible terrain inclination around Z (in driving direction)	0°
Maximum permissible terrain inclination around X (cross to driving direction)	0°
Maximum ground pressure on level ground	188kN/m ²
Maximum ground pressure at permitted ground inclination	725kN/m ²

Driving the drill rig with with drill mast positioned vertically (with drilling tools), see drawing to stability 1019022-00 on page 106	
Restrictions:	
Drill mast must be inclined 7° backwards (+Z) out of vertical position, alignment around D3. Drill mast must not be inclined sidewise (+/-X) out of vertical position, alignment around D4. The drill mast must be aligned centrally between the crawler tracks. The front end of the drill mast must be guided above the ground as close as possible, alignment by Z3 (+/-Y).	
Maximum permissible terrain inclination around Z (in driving direction)	0°
Maximum permissible terrain inclination around X (cross to driving direction)	0°
Maximum ground pressure on level ground	233kN/m ²
Maximum ground pressure at permitted ground inclination	308kN/m ²

Driving the drill rig with drill mast positioned vertically (without drilling tools),
see drawing to stability 1019022-00 on page 106

Restrictions:

Drill mast must be inclined 5° backwards (+Z) out of vertical position, alignment around D3.
Drill mast must not be inclined sidewise (+/-X) out of vertical position, alignment around D4.

The front end of the drill mast must be guided above the ground as close as possible, alignment by Z3 (+/-Y).

The drill head unit must be shifted forward in final front position up to the clamping device / centralizer.

Maximum permissible terrain inclination around Z (in driving direction)	2°
Maximum permissible terrain inclination around X (cross to driving direction)	2°
Maximum ground pressure on level ground	110kN/m ²
Maximum ground pressure at permitted ground inclination	210kN/m ²

Transport position,
see dimensional drawing 1019063-00 or chapter Technical Data

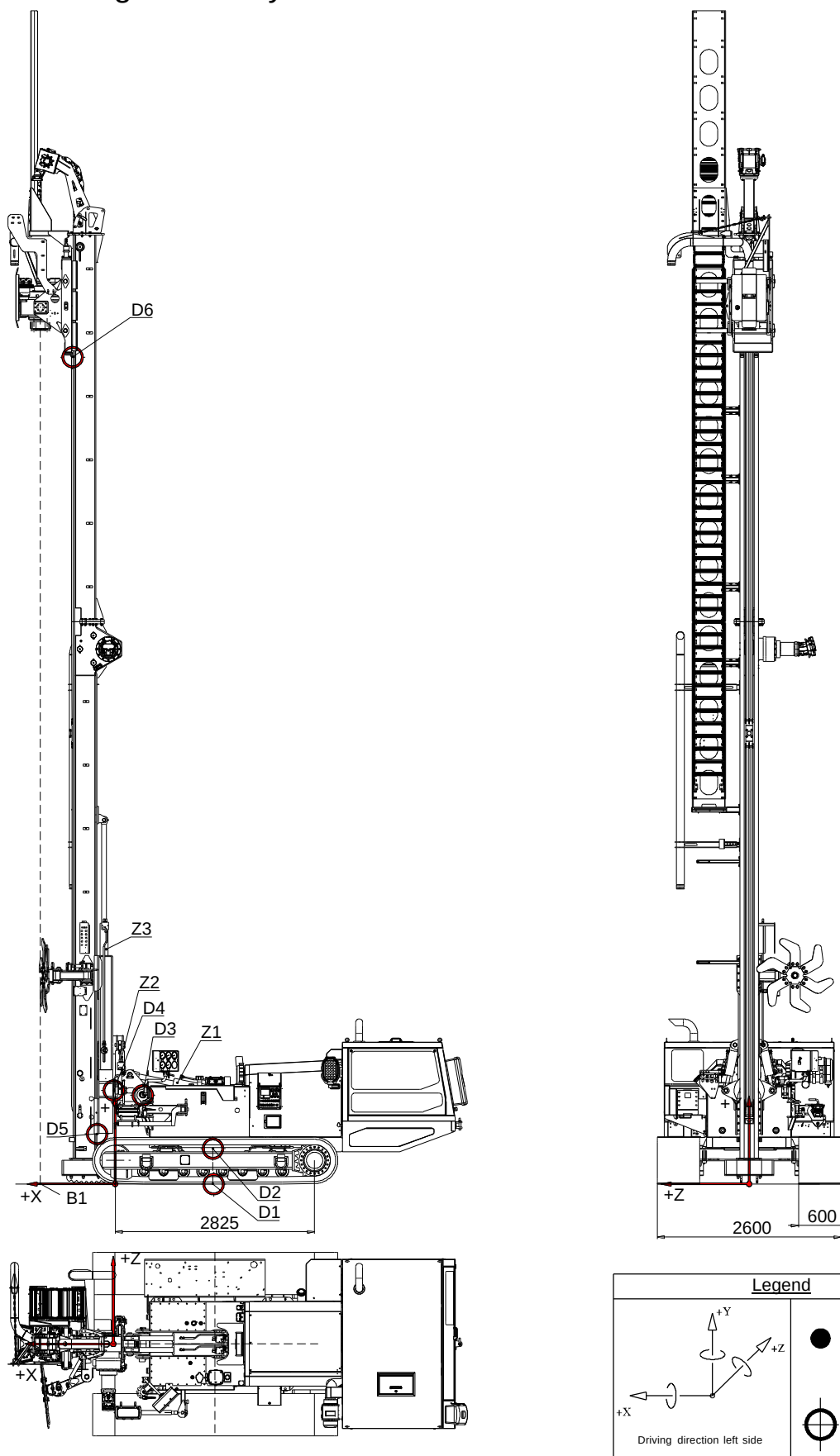
Restrictions:

Drill mast must be propped in marked position.

The drill head unit must be shifted forward in final front position up to the clamping device / centralizer.

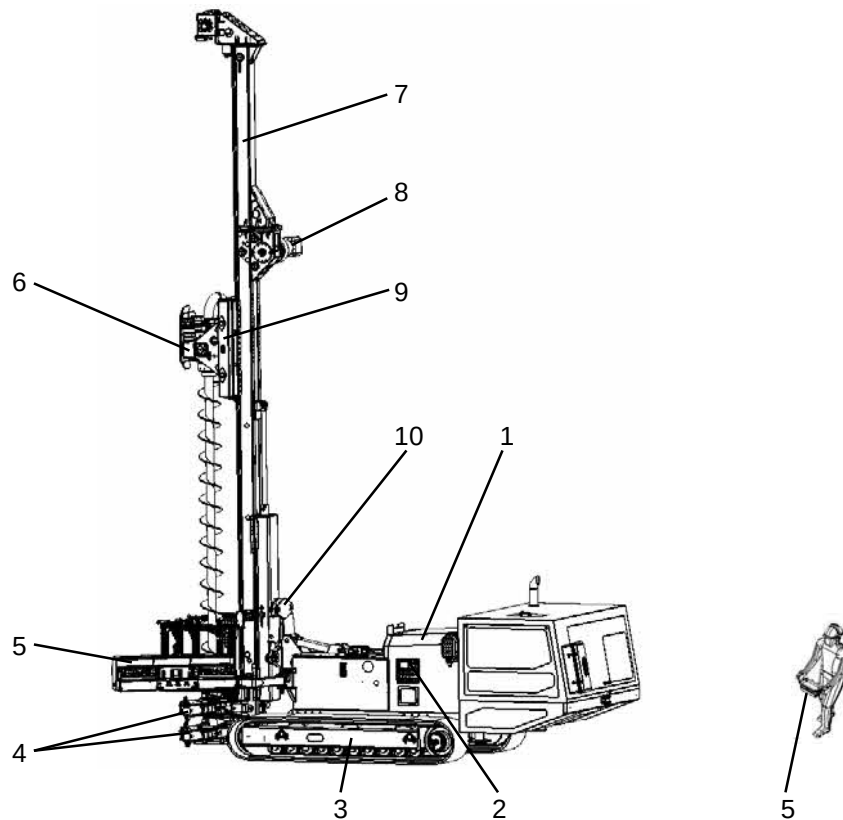
Maximum permissible terrain inclination around Z (in driving direction)	20°
Maximum permissible terrain inclination around X (cross to driving direction)	15°
Maximum ground pressure on level ground	165kN/m ²
Maximum ground pressure at permitted ground inclination	650kN/m ²

11.1 Drawing to stability 1019022-00



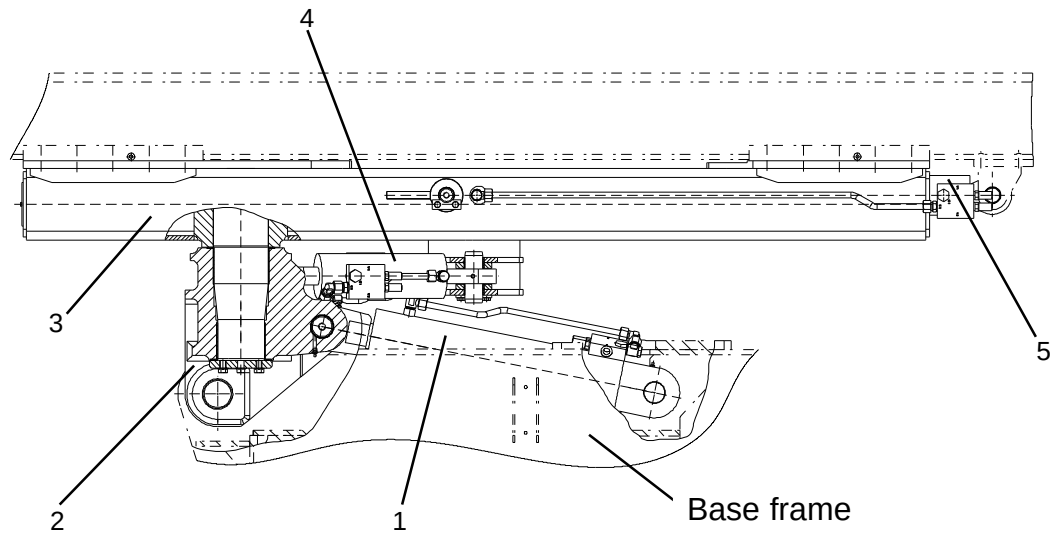
12 Technical description

12.1 Equipment overview



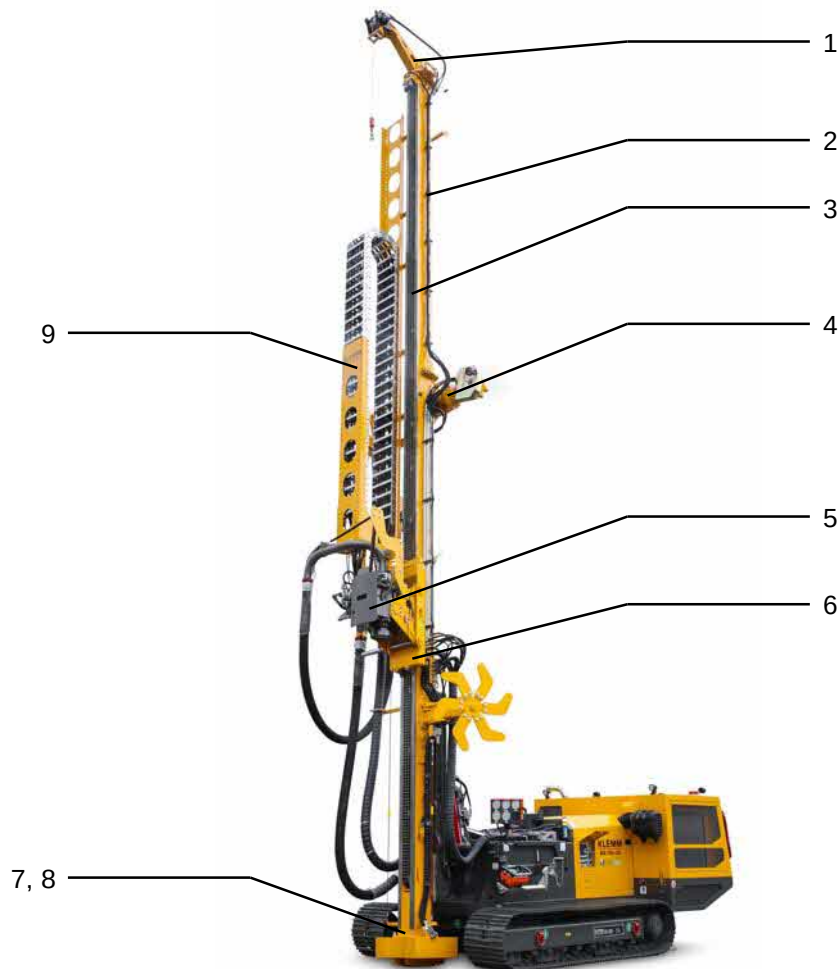
No.	Components	Function
1	Basic unit with attachments	Carries the boom with drill mast and the drill head unit as well as all for the function of the equipment necessary components.
2	Control box at the base unit with engine control box	Start- and monitoring elements of the equipment + various controls
3	Crawler tracks	Carries the basic unit with attachments and ensures the driving with the equipment.
4	Clamping- and breaking device	Guides the drill string and is used for installation and deinstallation of the drill rods
5	Control panel electrically / Radio remote control	Carries the operation elements for driving-, alignment- and drilling functions of the equipment.
6	Drill head unit	The drill head unit consists out of one or two drill heads. The drill head unit generates the rotational motion of the drill string. In dependence of the mounted drill head unit, percussion energy or vibrational energy is transmitted to the drill string.
7	Drill mast	Guides the feed sledge with drill head unit. Carries optional mountable devices for rod handling operations like rope winches, cat heads, rod magazine.
8	Feed gear	Produces the feed forces and feed movement as well as the retraction forces and retraction movements.
9	Glide sledge	Is moved on the drill mast by the feed chain and carries the drill head unit.
10	Boom	Carries and guides the drill mast with attachments and ensures the alignment of the drill mast.

12.1.1 Boom overview



No.	Components	Function
1	Hydr. cylinder drill mast tilting	Tilts the drill mast carrier and thus the drill mast forwards or backwards.
2	Slewing head	Is movably mounted to the base frame and carries the drill mast carrier.
3	Drill mast carrier	Is movably mounted to the slewing head and carries the drill mast.
4	Hydr. cylinder drill mast slewing	Carries out the sidewise slewing motion of the drill mast carrier and thus of the drill mast.
5	Hydr. cylinder drill mast displacement	Carries out the displacement motion of the drill mast on the drill mast carrier.

12.1.2 Drill mast overview



No.	Components	Function
1	Cat head with rope winch	Ensures rod handling into the drilling axis.
2	Drill mast	Guides the glide sledge with drill heads and carries further components.
3	Feed chain	Transmits the feed forces and feed motions of the feed gear to the glide sledge.
4	Feed gear	Carries out the feed forces and feed motions.
5	Drill head	Carries out the rotational motion of the drill string for drilling operation.
6	Glide sledge	Is moved on the drill mast by the feed chain and carries the drill head unit.
7	Breaking device (not already mounted)	Clamps the drill rods and breaks drill rod connections.
8	Clamping device (not already mounted)	Clamps the drill rods.
9	Hose guide	Guides the hydraulic hoses and the electric cables to the drill head unit.

12.2.2 Specifications of the equipment

Basic unit KR 709-3G	
Drive unit:	
Diesel engine Volvo Typ TAD 572 VE	160 kW / 2000 min ⁻¹
certified by	EEC 97/68 EC Stage 4, USA EPA/CARB TIER 4f
Serial number diesel engine	7005329711
Undercarriage:	
Traction force	approx. 120kN
Driving speed	max. 2,1km/h
Specific ground pressure	5,8N/cm ²
Total width	2400mm
Width of grousers	600mm
Length (distance of axles)	2765mm
Length of crawler units	3350mm
Ground clearance	320mm
Crawler type	3-rib, B1
Hydraulic system:	
Hydraulic pumps	2 x 240 l/min. Load-Sensing
	1 x 30 l/min. constant
	1 x 20 l/min. constant
	optionally 1 x 35 l/min. constant
System pressure	max. 350bar
Hydraulic tank capacity approx.	900 l
Fuel tank capacity	380 l
AdBlue®/DEF-tank capacity	45 l
Electrics	24V, 100Ah
Drill mast type 303/13	
Feed gear	Two-Speed
Feed force / retraction force	130kN / 65kN
Feed speed / retraction speed	4,9 / 10,5m/min
Fast feed speed / fast retraction speed	21,6 / 43,2m/min
Initial dimension (gauge) of the feed chain (1 link / 25 links)	38,1mm / 952,5mm
Drill head	
The specifications of the mounted drill head are to be taken out of the separate manual of the drill head.	
Rope winch	
Lifting force	max. 10kN

12.2.3 Permissible ambient temperatures

A trouble-free operation of the equipment can only be guaranteed in the standard-ambient temperature range of -20°C (-4°F) up to +40°C (+104°F)!

NOTICE

Risk of causing damage to components!

If operated outside the specified temperature ranges there is a risk of causing damage to the components.

Δ To operate outside the specified temperature ranges, a prior agreement with the manufacturer is required.

12.2.4 Noise emissions

In accordance to 2000/14/EC (Outdoor-Noise-Directive)

A-registered sound power level (L_{WA}) in different operating modes	
Measured sound power level L_{WA} :	
without loading (idle running of engine)	93 dB
with loading (full throttle of engine)	104 dB
with running drill head unit (rotating/rotating)	107 dB
with running drill head unit (rotating/rotating/percussion)	--- dB
Declared sound power level $L_{WAd(declared)}$:	
without loading (idle running of engine)	95 dB
with loading (full throttle of engine)	106 dB
with running drill head unit (rotating/rotating)	110 dB
with running drill head unit (rotating/rotating/percussion)	--- dB

A-registered sound pressure level (L_{PA}) in different operating modes	
Sound pressure level at the control panel of the machine L_{PAS} :	
without loading (idle running of engine)	65 dB
with loading (full throttle of engine)	75 dB
with running drill head unit (rotating/rotating)	84 dB
with running drill head unit (rotating/rotating/percussion)	--- dB
Sound pressure level in distance of 16m from the machine L_{PA16} :	
without loading (idle running of engine)	57 dB
with loading (full throttle of engine)	68 dB
with running drill head unit (rotating/rotating)	71 dB
with running drill head unit (rotating/rotating/percussion)	--- dB

12.2.5 Exhaust gas emissions

The indicated emission values concern the operation of the diesel engine without soot particle filter system.

Emission values diesel engine Volvo TAD572VE	
CO	3,500 g/KWh
HC	0,190 g/KWh
NOx	0,400 g/KWh
Particles	0,025 g/KWh

12.2.6 Vibration acceleration

The weighted value of the vibrations of the body (feet, seat face) of $0,5\text{m/s}^2$, which can shake the operator during the drilling work, is not exceeded. The value of the hand/the arm vibrations, which shake the operator during the drilling work, is under $2,5\text{m/s}^2$.

12.2.7 Permissible diesel engine inclination angles

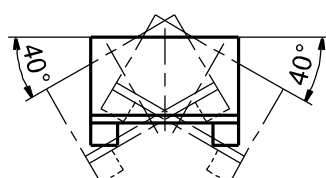
The following sketch shows the maximum permissible diesel engine inclination angles.

NOTICE

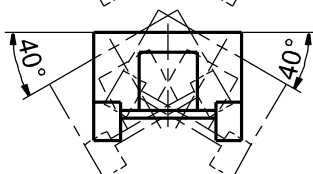
Risk of causing damage to components!

Extreme inclination angles can lead to damages to the diesel engine.

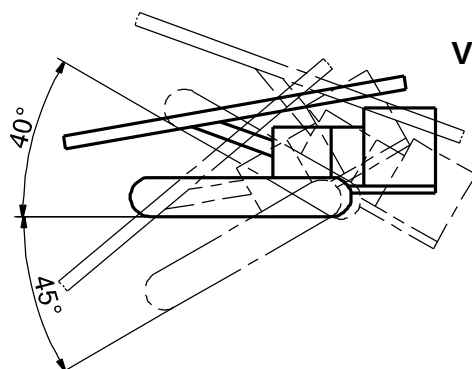
Δ To avoid heavy damages at the diesel engine, this inclination angles must not be exceeded.



View from the rear



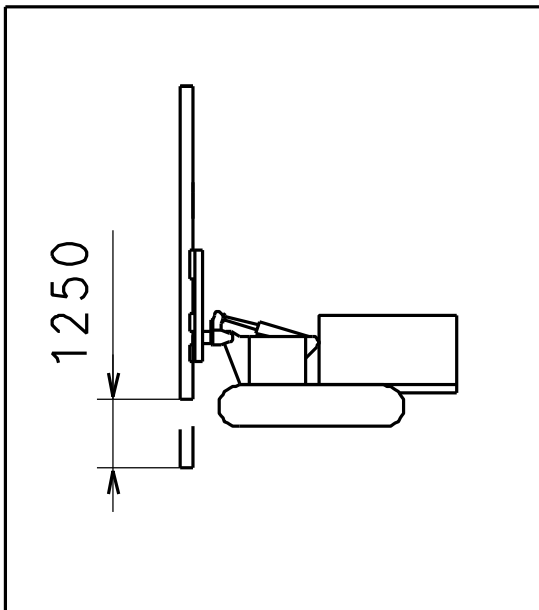
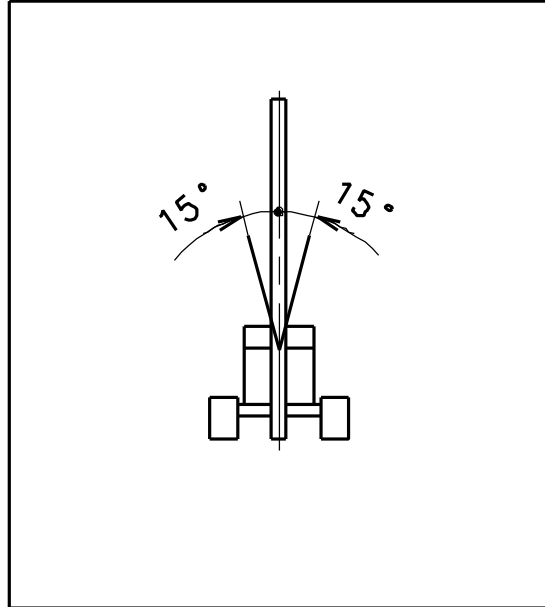
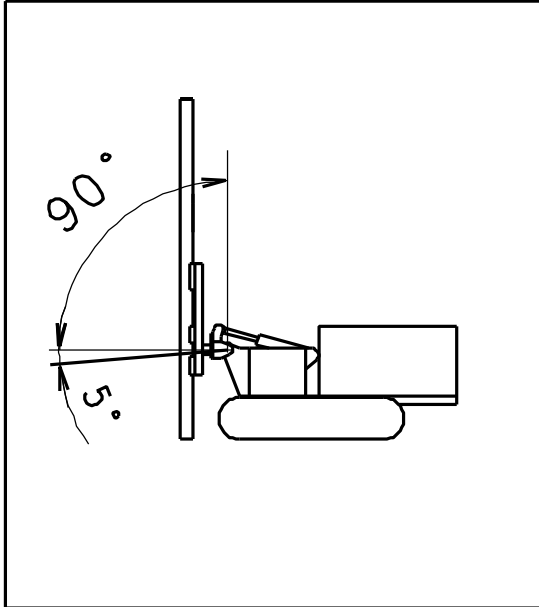
View from the front



View from the left

12.2.8 Swivelling ranges

Kinematic possible swivelling ranges KR 709-3G basic version. For special- and additional equipment differences must be discussed with KLEMM BOHRTECHNIK!



13 Operation of the equipment

13.1 Working configuration

Safe operation of the equipment depends on several conditions under which the equipment is operated. These operating conditions vary depending on the site and drilling task.

The following conditions are relevant:

Site situation

- Space conditions
- State / site facilities
- Indoors / outdoors
- available equipment

...

Drilling task

- Vertical drilling
- Inclined drilling
- Drilling depth
- Drilling method, drilling system

...

Equipment of the drill rig

- Magazine
- Lifting mechanism for drill rods
- Remote control
- Oscillating undercarriage

...

Personnel

- Operator
- Assistants

...

To adapt the equipment optimally to the operating conditions and thus to ensure safe working, the operator must set up and adjust the equipment. This must be done by preselection of the working configuration (see chapter 14.4).

13.2 Access to moving parts

Before executing the drilling task, the operator must decide whether it is foreseeable to enter the danger zone during the intended, normal operation.

He has to decide whether he provides the access to moving parts, which are directly involved in the working process during the intended, normal operation.

Following parts are moving parts, which are directly involved in the working process during the intended, normal operation:

- Drilling tools
- Drill rods
- Drilling accessories
- Drill rod clamps
- Drill rod breaking clamps
- Moving drill heads on the drill mast
- Feed chains
- Remote controlled handling systems
- ...

13.3 Decision on the work configuration

The operator decides how he uses the machine or how he wants to work with the machine. Due to the many different possible applications of a drill rig, the machine must be adjusted or configured to the works that should to be carried out.

The machines control system allows the setting of the working configuration via a menu on the machine display. The operators adjustment affects the functions of the machine.



The of the operator planned handling of the drill rods is the decisive criterion, if the access to moving parts that are directly involved in the working process is foreseeable on the job site during the normal operation of the machine.

In the machine control seven working configurations are accordingly available.

- Operation of the equipment with safety guard (EN 16228)
- Operation of the equipment without safety guard
- Operation of the equipment with barrier
- Operation of the equipment without handling of drill rods
- Operation of the equipment with a mechanised tool handling system
- Operation of the equipment with external equipment
- Set-up and maintenance / service

13.3.1 Selection of the working configuration, if the access to moving parts is foreseeable

Manual handling of drill rods

The operator or his assistant have direct contact with the drill rods. To work with the machine, the access to moving parts that are directly involved in the working process is required and foreseeable during the normal operation of the machine. Four variants are differentiated:

- Operation of the equipment with safety guard (EN 16228)
- Operation of the equipment with barrier
- Operation of the equipment without safety guard
- Operation of the equipment for set-up and maintenance / service

13.3.2 Selection of the working configuration, if the access to moving parts is not foreseeable

Mechanised handling of drill rods

The operator or his assistant have no direct contact with the drill rods. To work with the machine, the access to moving parts that are directly involved in the working process is not required and not foreseeable during the normal operation of the machine. Two variants are differentiated:

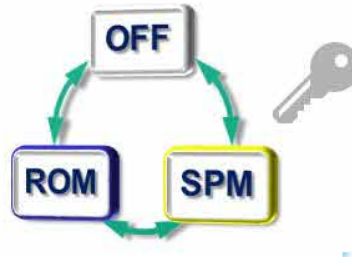
- Operation of the equipment with a mechanised tool handling system
The machine is equipped with a magazine which is controlled from a safe distance.
This magazine is part of the machine.
- Operation of the equipment with external equipment
The handling of the drill rods is done with a handling system, which is not part of the machine (e.g. mini excavator with gripping system).

Without handling of drill rods

- Operation of the equipment without handling of drill rods
During the normal operation of the machine, a handling of drill rods is not required.

13.4 Protective operation modes

To ensure a safe operation of the equipment, it has two protective operation modes which can be selected by the operator. Which mode is to be selected, is depending on the working configuration, the site situation and the working method of the operator. Switching into the protective operation modes must be activated by the operator by using a lockable operation mode selector switch.



13.4.1 No protective operation mode = OFF

It is only allowed to work without protective mode, if a working configuration is selected, in which the equipment is operated with a interlocking safety guard. This interlocking safety guard must be closed during operation. Before the safety guard can be opened, the operator must change into the operation mode ROM (Restricted operation mode).

13.4.2 Restricted operation mode = ROM

If it is necessary to enter the danger zone during the normal operation of the equipment with opened movable safety guard, the restricted operation mode must be selected.

This operation mode is maintained by the operation mode selector switch until the interlocking movable safety guard is closed and reset.

This mode can be used during setup, when performing maintenance works or when operating with special protection mode.

The restricted operation mode includes:

- a rotation speed of not more than 30 rpm or “inching operation” which allows not more than a half rotation per activation in the danger zone;

- a feed speed of not more than 15 m/min or “inching operation” which allows a feed path not more than 10 cm per activation in the danger zone; and

- operation elements with automatic resetting for the rotation function; and

- operation elements with automatic resetting for the feed function; and

- an indicator that informs the operator and the personnel, that the restricted operation mode is switched on. The indicator consists of a blue signal lamp in the signal tower.

If the operation elements with automatic resetting are released, the rotating parts stop after less than half a revolution.

13.4.3 Special protective mode = SPM

For the operation of anchor drill rigs special circumstances are known, in which the use of mechanical, interlocking safety guards and protective devices is not possible.

This special circumstances can be given by special applications, exceptional positions of the equipment or a non vertical alignment of the drill mast.

Examples for this are:

- the operation in confined spaces
- a restricted working area
- working near obstructions or buildings
- Drilling operations, in which the holes are not drilled vertically
- ...

For this special circumstances, the drill rig is equipped with a special protective mode that ensures a safe operation without safety guards.

When possible, interlocking safety guards and protective devices must remain attached to the equipment.



Danger of accident!

Non-observance of the following references can lead to serious or fatal accidents for persons.

- Δ In this operation mode, it is not permissible that the operator enters the danger zone when using a remote control. During the normal drilling process, he must maintain a sufficient distance from the danger zone, that he is not able to reach moving parts which are involved in the drilling process.

In this operation mode:

- the operation elements for rotation and feed function must be equipped with a automatic resetting
- the rotation and feed motion can be operated with normal operation speed
- a warning signal (optically and / or acoustically) must be activated, if the special protective mode is activated. The warning signal consists of a yellow signal lamp in the signal tower.
- pressure sensitive protective devices must be additionally installed

13.4.3.1 Automatic switching of SPM into ROM (option)

While the special protective mode (SPN) is activated, the rotation- and feed speed of the equipment is automatically reduced when installing or removing drill rods. Depending on the drilling system, this speed reduction is realized by automatically switching into the restricted operation mode (ROM). To avoid that tools are installed or removed at full speed, a sensor is installed in the clamping device which activates the slower rotation- and feed speed.

This switching from SPM into ROM when installing or removing the tools is realized differently for different drilling systems.

1. Single drill rod with one clamping device
Switching from SPM into ROM occurs automatically by means of a sensor which is installed in the clamping device.
2. Double drill rod (casing and rod) with two clamping devices
Because the drilling operation is often continued with the inner rod after the casing is set, two sensors are needed to switch from SPM into ROM. While the inner drill rod is drilled, the casing is clamped by the lower clamping device. By a switch, the sensor in the upper clamping device can be manually activated. If the sensor in the upper clamping device is activated, the sensor in the lower clamping device is not activated.
3. Cased drilling with augers / plug-in rods etc. with one clamping device
If the drilled casing is clamped in the clamping device in this drilling system, the control system would detect a tool change and switch from SPM into ROM. A normal drilling of the auger or the plug-in rods is hardly possible in the ROM. By a switch, the sensor in the clamping device can be manually deactivated. Drilling in the SPM is now possible.



Danger of accident!

Non-observance of the following references can lead to serious or fatal accidents for persons.

- Δ An automatic detection of a tool change with the sensor system of the equipment is not possible in this case. The operator must manually switch into the ROM during the tool change by using the operation mode selector switch.

13.4.4 Comparison of the operation modes

The operation modes are compared in the following table:

		OFF	ROM	SPM
Function „rotation“	Rotation speed	No restriction	Not more than 30 rpm* or inching operation	The rotation speed may correspond to the rotation speed in normal operation mode. This speed must be reduced when installing or removing drill rods. A sensor is to attach, which activates a slow rotation speed.
	Operation elements	No restriction	Operation elements with automatic resetting	Operation elements with automatic resetting
Function „feed“	Feed speed	No restriction	Not more than 15 m/min* or inching operation	The feed speed may correspond to the feed speed in normal operation mode. This speed must be reduced when installing or removing drill rods. A sensor is to attach, which activates a slow rotation speed.
	Operation elements	No restriction	Operation elements with automatic resetting	Operation elements with automatic resetting
Indicator / Warning signal		No	Required (signal lamp blue) Operator and the personnel get informed that the restricted operation mode is switched on (see chapter 14.10).	Required (signal lamp yellow) A warning signal is activated if the special protective mode is activated (see chapter 14.10).
Additional pressure sensitive protective devices EN 16228		Existing	Existing	Existing
Pressure sensitive devices (trip wires) EN 791		Intended by the manufacturer	Intended by the manufacturer	Required

***ATTENTION!**

If the factory-supplied drilling system is changed, these values are to be checked. The operator must ensure that these max. permitted values are not exceeded. When exceeding the values the equipment must not be operated anymore. Contact the service department of KLEMM Bohrtechnik.

13.4.5 Selection of the operation mode

In certain working configurations it is only allowed to operate the machine in certain protective operation modes.

By using the following table, the operator of the equipment can identify the possible operation modes, depending on the working configuration.

Is the access to the danger zone foreseen by the operator?	Must the equipment be fitted with a safety guard under the current conditions?	Are known circumstances, in which the use of safety guards is not possible? ¹⁾	Is it allowed to operate the equipment without interlocking safety guard?	Possible working configurations	Protective operation modes ²⁾		
					OFF	ROM	SPM
no	no		no	with mechanised tool handling system	X		
				with external equipment	X		
yes	yes	no	no	with interlocking safety guard		3)	
		yes	yes	without interlocking safety guard	X ⁴⁾	5)	
				without handling of drill rods	X ⁴⁾	5)	

¹⁾ The question must only be answered if the drill rig must be equipped with a safety guard.

²⁾ ⇒ possible operation mode, ⇒ alternative operation mode, X ⇒ operation mode not permitted.

³⁾ To open the safety guard, the operation mode ROM must be chosen first.

⁴⁾ If no safety guard is installed, the device may only be operated in one of the protective operation modes.

⁵⁾ While the special protective mode SPM, the reduce of the rotation- and feed speed of the equipment when installing or removing drill rods is achieved by the automatic activation of the restricted operation mode.

14 Operation



Danger of accident!

Improper use can cause an accident. This could result in serious or fatal injuries to persons.

Δ Please read and observe all safety chapters and all associated subchapter before performing tasks or processes according to this chapter!

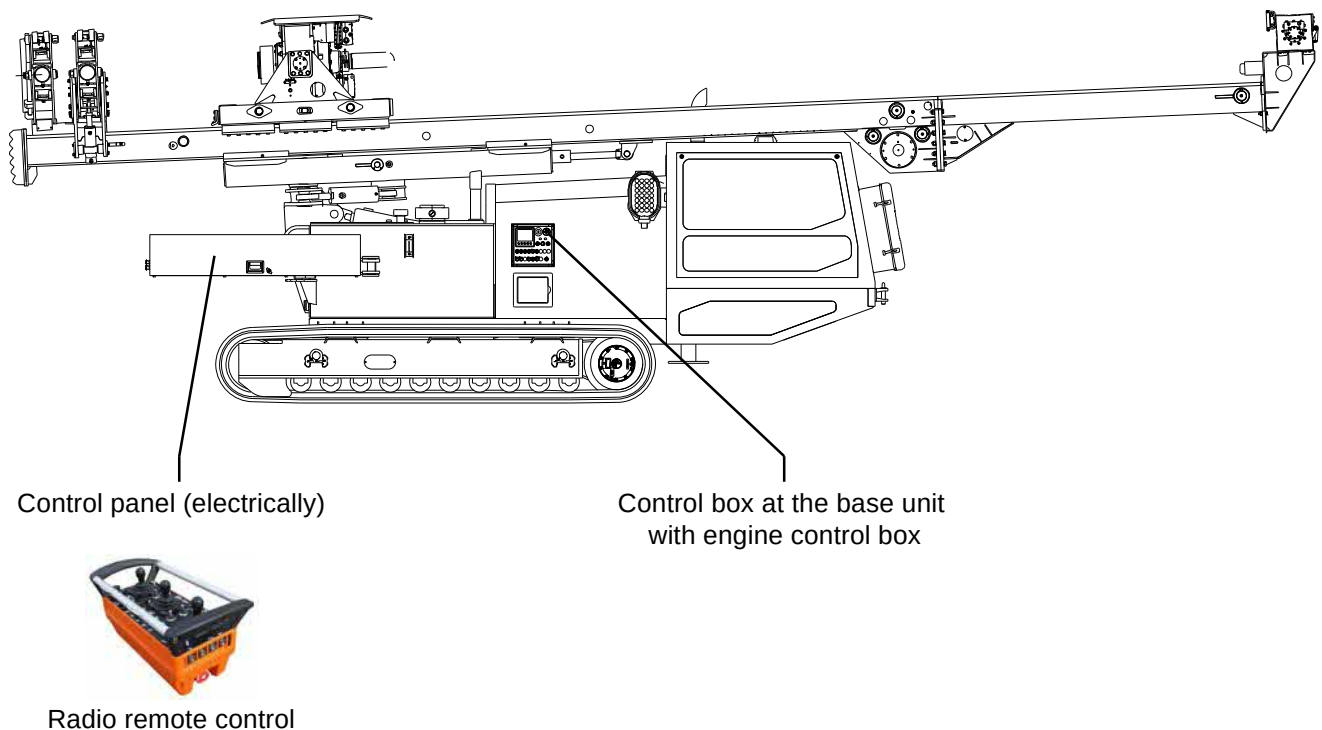
14.1 Control points on the equipment

The equipment has several control points that are necessary for various operations. The main control points are:

1. Control box at the base unit with engine control box
2. Control panel (electrically) with drilling and alignment functions
3. Radio remote control with drilling and alignment functions

Further control points are located on optional mountable additional devices. This control points are shown and described in the corresponding additional chapters.

The following figure shows the positions of the main control points at the equipment.



14.2 Start-up

14.2.1 Initial start-up

Typically, the equipment manufacturer performs initial start-up together with the future owner. The work necessary to accomplish this is performed either as part of training at the manufacturer or through instruction on-site.

14.2.1.1 Removal of protective wax

The equipment is coated with a special protective wax especially for longer transport routes. This protects the equipment against the effects of the weather.



Danger of slipping!

Incorrect cleaning can lead to slipping and falling of personnel.

- Δ Before commissioning the equipment, completely remove the protective wax from the entire equipment and its accessories.
- Δ Wear suitable personal protective equipment while cleaning.

NOTICE

Risk of causing damage to components!

Unsuitable cleaning agents can cause damage to seals and other sensitive components.

- Δ Only use suitable cleaning agents
- Δ Observe the instructions to safety when cleaning the equipment on page 86.

Clean the entire equipment and its accessories thoroughly with a steam-jet device at 80 °C to 100 °C (176 °F to 212 °F) and completely remove the protective wax.

14.2.2 Start-up after long-term shutdown or storage

NOTICE**Risk of causing damage to components!**

Incorrect startup or removal of protective wax following long-term shutdown or storage can result in damage to the equipment.

Δ In the case of longer standstills (> 1 year), perform maintenance according to the maintenance tables (see "Maintenance and repair").

Δ Take any national and regional regulations regarding equipment inspections into account.

Δ Perform the measures described below.

Equipment with all attachments

Remove protective wax before starting the equipment (see "Removing protective wax").

Hydraulics

Remove any corrosion protection from the hydraulics in a suitable manner.

Visually check the hydraulics for leaks.

Diesel engine

Before starting up the diesel engine, remove protective wax properly and perform maintenance in accordance with the manufacturer's specifications.

Kinematic

Remove any corrosion protection in a suitable manner.

Lubricate greasing points.

Cylinders and piston rods

Check the surface of the cylinders and piston rods for corrosion before start-up and remedy accordingly (see Chapter on "Maintenance/repair").

Replace any highly corroded, leaky cylinders and piston rods.

Electrical equipment/electrical cables

Before start-up, check that the electrical equipment and electrical cables are in proper working order and replace if necessary.

Connect the equipment's power supply (see "Making the equipment operational").

Ropes

Check ropes for integrity and corrosion before start-up and replace if necessary.

14.2.3 Daily start-up

14.2.3.1 Visual check before daily start-up

NOTICE**Danger of damage to equipment!**

Any unresolved deficiencies can cause damage to the equipment.

Δ Visually check the equipment before each start-up.

Δ Have the defect repaired by an authorized technician.

Check the entire equipment and accessories for completeness.

Make sure that the screw connections and plug connections on the machine and accessories are secure and complete.

Check all components, particularly load-bearing steel components and rope, for integrity and wear.

Check all electrical, hydraulic and pneumatic components for integrity and correct connection.

Be sure to check for fluid build-ups or leaks.

Ensure all operating fluids are at required levels.

Compare the hours on the operating hours meter with the specified maintenance intervals and perform any pending maintenance tasks.

Check that lighting equipment (option) is in proper working order.

Check that signaling devices are in proper working order.

14.2.3.2 Making the equipment operational

Perform the measures outlined in the chapter "Visual check before daily start-up".

Set the battery main switch to position "I".



Battery main switch

NOTICE

Before any maintenance or repair works as well as in emergency, the battery main switch must be turned to the left (anticlockwise) to interrupt the electrical circuit (see instructions in chapter 14.4.6.1 on page 158).

After completion of the works, the battery main switch must be turned to the right (clockwise) to close the electrical circuit again.

Close all doors and maintenance flaps and mount the protective coverings.

NOTICE

Risk of causing damage to equipment!

Uncontrolled movements of the equipment can cause damage to the components. Set all operating elements to the "0" position.

Unlock all EMERGENCY-STOP

Open all closed shut-off valves for fuel and hydraulic oil.

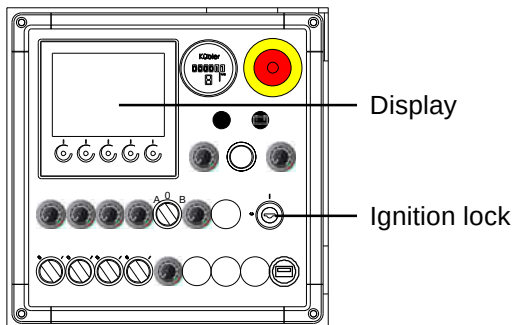
Check the fuel level. If necessary, replenish fuel.

Check the charging state of the battery. If necessary, charge the battery or replace with a new one.

Starting the equipment (see following chapter).

14.2.3.3 Starting the equipment

1. Set engine rpm control potentiometer at the control panel / remote control console to approx. quarter speed. The potentiometer with the highest setting controls the engine speed.
2. Insert starter key into ignition lock and turn clockwise to position 1.



3. Start of electrically controlled equipment

1. System Radio remote control

If only the system “Radio remote control” is installed, the start sequence, which is described in the corresponding chapter to the radio remote control, must be observed. The socket for the control system “Electric control panel” at the base machine must be fitted with the corresponding dummy plug.

2. System Electric control panel

If only the system “Electric control panel” is installed, the device can be started by the start button at the electric control panel after switching on the engine monitoring. The socket for the control system “Radio remote control” at the base machine must be fitted with the corresponding dummy plug.

3. System Radio remote control and Electric control panel

If both systems are installed, the equipment can be started via the radio remote control as described in point one.

If the equipment should be started via the start button of the electric control panel, the start sequence of the radio remote control must be carried out until the actual start of the equipment. If only one of the both installed systems is used, the not used system can be deactivated by disconnecting the cable with multi-pin plug from the corresponding socket and connecting of the dummy plug.

Then, the equipment can be started as described for the corresponding system under point 1 or 2.

If the radio remote control system is deactivated, it is not longer necessary to carry out the start sequence of the radio remote control when you start the equipment via the electric control panel.

Further information on the operation of the control systems can be found in the optional descriptions of the control systems.



To start electrically controlled equipment, please note chapter „Operation control systems electrically controlled equipment“ in the manual.

NOTICE**Risk of causing damage to diesel engine!**

A cold diesel engine can be damaged when operated at full load.

- Δ Never start the engine with engine is running and the the starter is rotating.
- Δ Cold diesel engines should first be brought to the operating temperature at idling speed.

14.2.3.4 Jump starting the equipment

NOTICE**Risk of causing damage to the electrical control system!**

When jump starting the equipment, voltage peaks can damage/destroy the electrical control system.

- Δ Never connect the earth directly to the battery.
- Δ For jumping starting the equipment, use an electrical voltage source that corresponds to the vehicle power supply.

14.2.3.5 Start-up in cold ambient temperature conditions

Let the hydraulic system cycle to "warm-up" (see description below). The optimum operating temperature for hydraulic oil depends on the viscosity class of the used hydr. oil (see chapter 16.4.2). By warming up the hydraulic system, the regular sensitivity of the hydraulic system is reached. If the drill rig is operated at lower oil temperatures without accomplished warming-up phase, the retarded responding of the hydraulic functions occur.

Warm up the hydraulic system at outside temperatures less than 5°C (41°F)

- Start the engine
- 2 Minutes idle running
- Increase engine speed to approx. 1500 rev/min.
- Actuate casing rotation (slow gear) and let it run for 5-10 minutes until the oil is "hand warm".

Warm up the hydraulic system at outside temperatures higher than 5°C (41°F)

- Start the engine
- 1 Minutes idle running
- Increase engine speed to approx. 1500 rev/min.
- Actuate casing rotation (slow gear) and let it run for 3-5 minutes until the oil is "hand warm".

NOTICE

Risk of causing damage the hydraulic system!

Non observance of the warm-up phase can lead to cavitation damages at the pumps as well as delayed reactions of the hydraulic functions!

Δ When operating a KLEMM Bohrtechnik hydr. drifter, an hydraulic oil viscosity of 16...36 mm²/s has to be provided in order to avoid excessive wear or damage (see also chapter 16.4.2 on page 223).

14.3 Decommissioning

14.3.1 Brief interruptions or end of work

Only position the equipment on horizontal and level ground with a sufficiently stable surface.

Position the equipment so that it does not block traffic.

Align the mast vertically and prop it to the ground.

Lower fittings and moveable loads as far as possible.

Set all operating elements to the "0" position.

Switch off the diesel engine by turning the ignition key to position "0".

Remove the ignition key.

Remove key of battery main switch (see instructions in chapter 14.4.6.1 on page 158).

Close the maintenance flaps, and all other doors when you leave the equipment.

The equipment has been shut off.

14.3.2 Long-term shutdown or storage

Prerequisite: The equipment has been shut off (see chapter 14.3.1).

Base unit with drill mast and attachments

NOTICE

Risk of causing damage to components!

Improper storage during longer-term shutdowns of the equipment can cause damage to the components.

Perform the measures described below.

Base unit with drill mast and attachments

Before longer downtime periods, perform the appropriate conservation measures on the base unit, the drill mast and the attachment (e.g. apply protective wax).

Hydraulics

NOTICE

Risk of causing damage to the hydraulics!

During longer downtime periods, it is possible for water to accumulate in the hydraulic tank, particularly if bio-oil is used. When the equipment is started up, this water could get into and damage the hydraulic system.

Check the hydraulic tank for water accumulations regularly and before start-up, and remove any water accumulations found.

Before longer downtime periods, fill the hydraulic system completely with oil.

If bio-oil is used, special measures must be undertaken. Always consult the manufacturer.

Diesel tank

To protect from corrosion, fill the diesel tank completely with diesel.

Diesel engine

Switch on the diesel engine every 2 or 3 weeks and let it run for a short time.

Cylinders and piston rods

Check the material surface of the cylinders and piston rods for rust and dust.

Clean and conserve the cylinders and piston rods in accordance with the chapter "Maintenance and repair".

Hoses

Store the hoses in a cool, dry, and dust-free place. Protect against direct sunshine and UV radiation. Observe the minimum permissible bending radii.

Have hoses regularly inspected by a specially qualified person. Be sure to observe national standards and guidelines in the country of use.

Electrical equipment and electrical cables

Store the electrical cables and electronic components in a cool, dry, and dust-free place. Protect against direct sunshine and UV radiation.

Set the battery main switch to position "0".

Guides

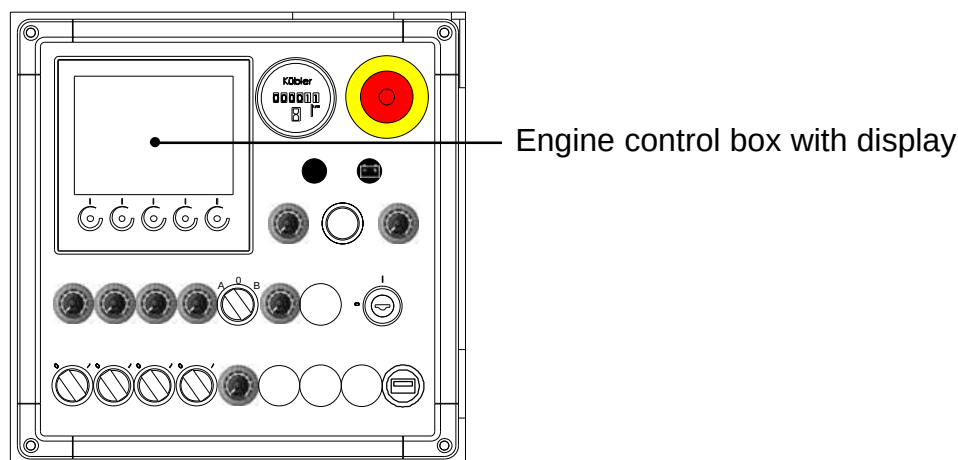
Check the material surfaces of the guides for rust and dust.

Clean and conserve the material surfaces.

14.3.3 Shutdown

Shut off the equipment (see chapter 14.3.1).

14.4 Engine control box with display



14.4.1 General information to the control unit with display

1. General

The control unit is equipped with a touch display and has 5 touch keys at the bottom.



Above the Touch keys, the current function is indicated.

 All objects that can be selected by the touch function are marked with a red triangle in the top left corner.

2. Code protected areas

Some areas in the menu are protected by different codes and indicated by a closed lock. Press and hold the lock symbol at least 2 seconds to enter the protected area. If the lock is selected only briefly, system data can be displayed or special functions can be released by entering the appropriate code. The open lock is displayed in different colours, depending on the area that has been released.

Code protected areas		
Screen	Illustration of the lock	Description
	 closed yellow	Areas code protected. No display.
	 opened yellow	Read-only area Press and hold the lock symbol at least 2 seconds. Afterwards all system variables are shown read-only.
	 opened green	Customer area Enter a 4-digit number code (3 (month + day) 3) Example: 3 (21. of July $\Rightarrow 21+7 = 28$) 3 = 3 2 8 3 Afterwards, all system variables that are relevant and adjustable for the customer are displayed.

3. Key assignment

In all menus, the key assignment is shown in the bottom of the display. After switching on the equipment and the appearance of the start screen, three working screens (pages) can be selected by pressing the appropriate key (see following table).

Key assignment			
Start screen	Key no.	Pictogram	Function
 1 2 3 4 5	1		Menu diesel engine
	2		Menu system pressures
	3		Menu mast inclination
	4		Option
	5		Menu service

4. Selection of the working configuration

If the start screen is not indicated after starting the equipment, but the selection of the working configuration is required, the following screen appears:



To select the working configuration, see instructions in chapter 13 from page 115. The request for selection the working configuration can be set between 1 and 10 days (see chapter 14.4.5.8 on page 154) and is indicated in the display after switching on the ignition. If no selection is made, working with the equipment is only possible in the special protective mode (SPM). After selection of the working configuration, the start screen appears. On the start screen, the menu “diesel engine” is displayed. All further menus can be selected by the touch keys.

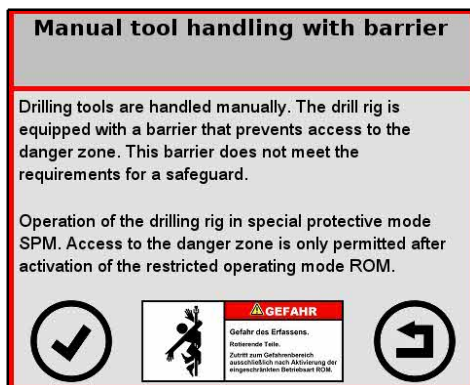
Messages for the selection of the working configuration

The following messages are displayed after selection of the corresponding working configuration and must be read and acknowledged.

Working configuration: with safety guard (EN 16228)



Working configuration: with barrier



Working configuration: without safety guard



Working configuration: with a mechanised tool handling system

Mechanized tool handling with an integral mechanized tool handling system

Drilling tools are handled mechanically. The drilling rig is equipped with an integral mechanized tool handling system according to EN 16228. Access to the danger zone during normal operation is avoided by appropriate measures taken by the operator.

Access to the danger zone is forbidden.



GEFAHR
Gefahr des Erfassens.
Rotierende Teile.
Betriebs des Bohrgerätes in der Schutzstromkreisart SPB. Zutritt zum Gefahrenbereich verboten.

Working configuration: with external equipment

Mechanized tool handling with an external mechanized tool handling system

Mechanized handling of drilling tools with an external mechanized tool handling system. Access to the danger zone during normal operation is avoided by appropriate measures taken by the operator.

Access to the danger zone is forbidden.



GEFAHR
Gefahr des Erfassens.
Rotierende Teile.
Betriebs des Bohrgerätes in der Schutzstromkreisart SPB. Zutritt zum Gefahrenbereich verboten.

Working configuration: without handling of drill rods

No tool handling

No handling of drilling tools. Access to the danger zone during normal operation is avoided by appropriate measures taken by the operator.

Access to the danger zone is forbidden.



GEFAHR
Gefahr des Erfassens.
Rotierende Teile.
Betriebs des Bohrgerätes in der Schutzstromkreisart SPB. Zutritt zum Gefahrenbereich verboten.

Working configuration: Set-up and maintenance / service

Set-up, maintenance and service

Set-up, maintenance and service.

Operation of the drilling rig only in the restricted operating mode ROM.



GEFAHR
Gefahr des Erfassens.
Rotierende Teile.
Zutritt zum Gefahrenbereich ausschließlich nach Aktivierung der eingestellten Betriebsart ROM.

5. Error messages

All active errors are displayed in the upper screen area. Several errors are displayed successively.

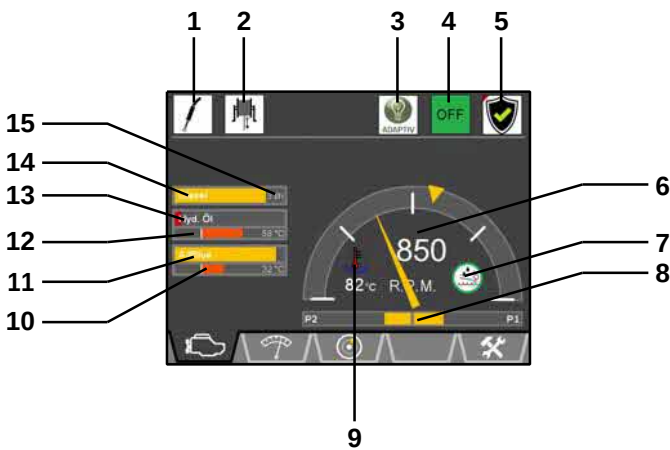


By touching the error bar, details to the error are displayed (see following example).

Example details to the error		
Screen	No.	Description
	1	Displayed error
	2	Number of the occurred errors (if several errors have occurred, these can be selected via the arrow keys)
	3	Number of the control
	4	Error number
	5	Detail number
	6	Detail of the error
	7	Error
	8	Error location

14.4.2 Menu diesel engine

In the menu “diesel engine” (start screen) the following information are displayed.

Menu diesel engine		
Screen	No.	Description
	1	Cleaning device active
	2	Rope winch active
	3	Option EEP-assist (Energy Efficient Power) Description EEP-assist see chapter 14.5 on page 160. Operation EEP-assist see description chapter 14.4.5.3 on page 147.
	4	Present mode (OFF, ROM, SPM)
	5	State of the safety device Touching the icon takes you to the menu “safety device” (see chapter 14.4.5.8 on page 154).
	6	Engine speed
	7	EATS symbol (see chapter 14.4.2.1 on page 139).
	8	Power Sharing
	9	Temperature cooling fluid diesel engine (°C)
	10	Temperature ®AdBlue (°C)
	11	Filling level ®AdBlue
	12	Temperatur Hydrauliköl (°C)
	13	Filling level hydraulic oil
	14	Filling level diesel
	15	Actual fuel consumption (l/h)

14.4.2.1 EATS Warnings and Inducement

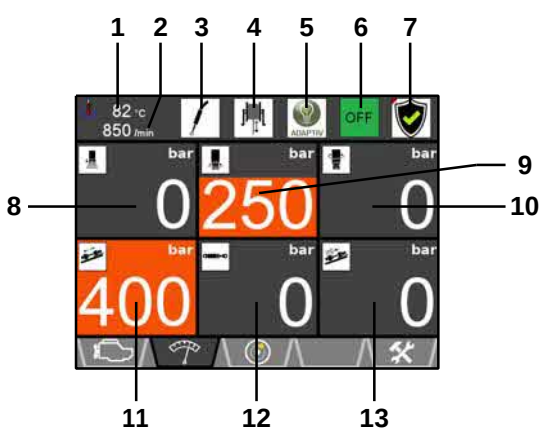
EATS system monitoring checks the quality of the urea solution, the level in the tank and the correct function of the system components. If a fault is detected the operator is warned via the instrument panel and engine power is limited.

Further information must be taken from the engine manufacturers documentation.

EATS display		
Screen	EATS symbol	Description
 EATS symbol	 Symbol green	No warning, normal operation
	 Symbol yellow	Deterioration warning
	 Symbol red	Power reduction active

14.4.3 Menu system pressures

In the menu “system pressures” the following information are displayed.

Menu system pressures		
Screen	No.	Description
 The screenshot shows a control panel with various indicators and pressure readings. Callouts point to specific elements: 1 points to the temperature display (82 °C), 2 to the engine speed (850 min), 3 to the cleaning device status, 4 to the rope winch status, 5 to the EEP-assist option, 6 to the present mode (OFF), 7 to the safety device status, 8 to the pressure drifter percussion (0), 9 to the pressure rotation inner drill string (250), 10 to the pressure rotation outer drill string (0), 11 to the pressure feed function (400), 12 to the pressure of the cylinder functions (0), and 13 to the pressure load compensation (0).	1	Temperature cooling fluid diesel engine (°C)
	2	Engine speed
	3	Cleaning device active
	4	Rope winch active
	5	Option EEP-assist (Energy Efficient Power) Description EEP-assist see chapter 14.5 on page 160. Operation EEP-assist see description chapter 14.4.5.3 on page 147.
	6	Present mode (OFF, ROM, SPM)
	7	State of the safety device Touching the icon takes you to the menu “safety device” (see chapter 14.4.5.8 on page 154).
	8	Pressure drifter percussion
	9	Pressure rotation inner drill string
	10	Pressure rotation outer drill string
	11	Pressure feed function
	12	Pressure of the cylinder functions
	13	Pressure load compensation

14.4.4 Menu mast inclination

In the menu “mast inclination” the following information are displayed.

Menu system pressures		
Screen	No.	Description
	1	Temperature cooling fluid diesel engine (°C)
	2	Engine speed
	3	Cleaning device active
	4	Rope winch active
	5	Option EEP-assist (Energy Efficient Power) Description EEP-assist see chapter 14.5 on page 160. Operation EEP-assist see description chapter 14.4.5.3 on page 147.
	6	Present mode (OFF, ROM, SPM)
	7	State of the safety device Touching the icon takes you to the menu “safety device” (see chapter 14.4.5.8 on page 154).
	8	Mast inclination to the left / right
	9	Mast inclination forward / backward

14.4.5 Menu service

If the menu “service” is selected, the following navigation screen is displayed.

By selection of the corresponding menu, it is possible to make settings or carry out diagnosis of various system components.

Menu service		
Screen	No.	Description
	1	Display settings
	2	Machine data
	3	Engine data
	4	Controls inputs / outputs
	5	Operating unit
	6	CAN nodes
	7	Electric control blocks
	8	Safety device
	9	Functions
	10	System parameters

14.4.5.1 Menu display settings

If the menu “display settings” is selected a container appears, in which further submenus can be selected.

Menu display settings		
Screen	No.	Description
	1	Settings mast inclination (option)
	2	System pressures
	3	Display data

Submenus in the menu display settings

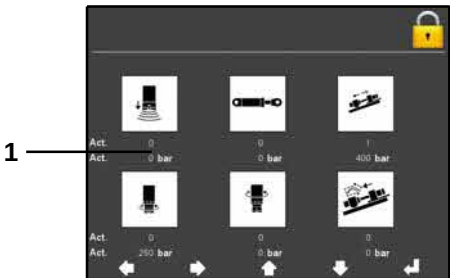
1. Submenu settings mast inclination (option)

In the menu “settings mast inclination” settings for the Offset between the real and the displayed mast inclination can be made.

Menu settings mast inclination		
Screen	No.	Description
	1	By touching the icon Offset, the mast inclination of the corresponding axis is set to zero.
	2	Displays the status of the sensor. ON = Sensor active OFF = Sensor inactive

2. Submenu system pressures

In the menu “system pressures” the following information are displayed.

Menu system pressures		
Screen	No.	Description
	1	Display raw and normalised values of the pressure sensors.

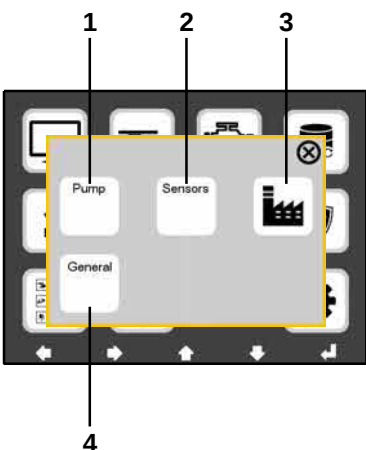
3. Submenu display data

In the menu “display data” the following information are displayed. Date, time, language and colour scheme can be adjusted without entering a code.

Menu display data		
Screen	No.	Description
	1	Date
	2	Time
	3	Language
	4	Colour scheme
	5	Current temperature of the display
	6	Operating hours of the display
	7	Current operating voltage
	8	Project name of the software

14.4.5.2 Menu machine data

If the menu “machine data” is selected, a container opens in which further submenus can be selected.

Menu machine data		
Screen	No.	Description
	1	Pumps
	2	Sensors
	3	Settings
	4	General

Submenus in the menu machine data

1. Submenu pumps

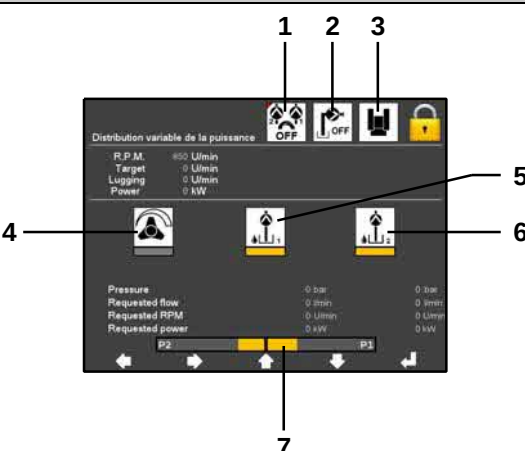
In the menu “pumps” the following information are displayed and various settings can be made.

Setting Power Sharing:

OFF: The power is distributed evenly to the pumps P1 and P2.

ON: The power can be manually distributed to the pumps P1 and P2.
Regulation by a potentiometer at the control box at the base unit -
see chapter 14.14 from page 200.

AUTO: The power is distributed on the pumps P1 and P2 automatically as needed.

Submenu pumps		
Screen	No.	Description
	1	Power Sharing (OFF / ON / AUTO)
	2	Water pump (OFF / ON)
	3	Driving active
	4	Potentiometer Power Sharing
	5	Activation of pump 1 (raw value)
	6	Activation of pump 2 (raw value)
	7	Power sharing between pump 1 and pump 2

2. Submenu sensors

In the menu "sensors" the following information are displayed.

Submenu sensors		
Screen	No.	Description
	1	- Hydraulic oil temperature - Shut-off temperature - Oil cooler switch-on temperature - Oil cooler temperature for maximum speed
	2	Hydraulic oil level
	3	Diesel level
	4	Shut-off temperature of various hydraulic oil types

3. Submenu settings

In the menu "settings" the factory settings can be restored. By loading the factory settings all values are set back to the factory state (volume flows, system pressures, shut-off temperatures...).

Submenu settings		
Screen	No.	Description
	1	Load factory settings after touching the message "load", the loading process must be further confirmed or canceled by touching of the shown container.

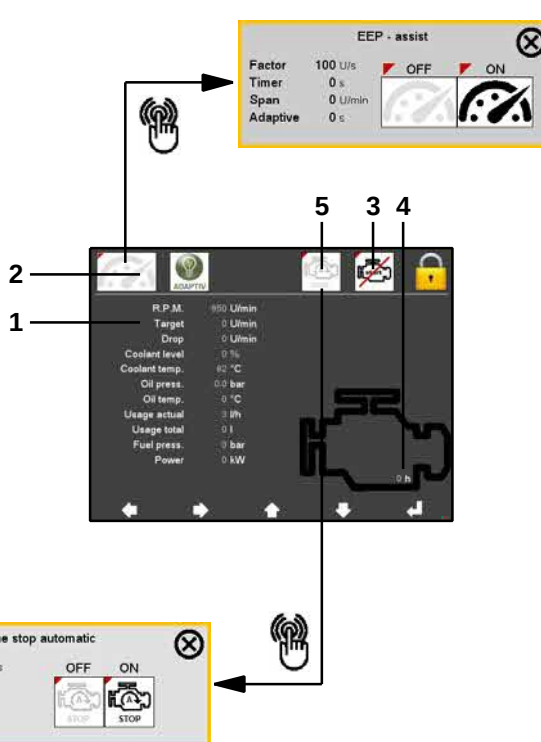
4. Submenu general

In the menu “general” the submenu “error storage” can be selected. After selection of the submenu “error storage” the following operation is possible.

Submenu general + error storage		
Screen	No.	Description
The diagram illustrates the user interface for the 'error storage' submenu. It shows two screens. The first screen, labeled '1', is the 'general' menu, which contains a document icon with a lock and a USB icon labeled '2'. The second screen, labeled '6', is the 'error storage' submenu, which contains a USB icon labeled '2', a copy icon labeled '3', a progress bar labeled '4', a trash icon labeled '5', and a display of '0 MB intern' labeled '6'. An arrow indicates the transition from the 'general' menu to the 'error storage' submenu.	1	Error storage
	2	Indication that USB Stick is ready. By touching the icon, the USB stick is removed safely.
	3	Copy the error storage on USB stick.
	4	Copying progress in %
	5	Clear error storage. Only possible after release.
	6	Internal memory (display).

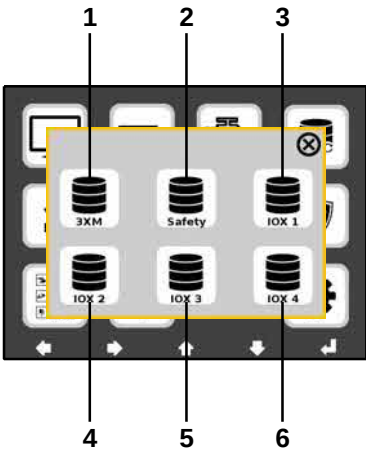
14.4.5.3 Menu engine data

In the menu “engine data” the following information are displayed and various settings can be made.

Menu engine data		
Screen	No.	Description
	1	Current engine data
	2	Operation EEP-assist After touching the icon, the shown container appears with the following setting options: - EEP-assist on / off - Factor = speed reduction in U/s - Timer = start of the speed reduction if no function was operated for X seconds - Span = Difference between current and calculated speed - Adaptive = the set span must exceed this time, then the engine speed is calculated.
	3	Start lock engine (on / off) If the start lock is switched on, no diesel is injected into the engine (starter turns).
	4	Engine working hours
	5	Engine STOP automatic After touching the icon, the shown container appears with the following setting options: - Engine STOP automatic on / off - Timer = the time in which no function is activated and the engine shutdown after expiration of that time. For shutdown process, the following conditions must be met. - Engine speed <900 U/min - Coolant temperature >10°C - Coolant temperature <100°C - Engine oil temperature >40°C - Supply voltage >24,5 VDC Optional: - Loading of the particle filter < 92%
	6	Indication automatic Engine STOP If the engine was shutdown by the engine STOP automatic, the shown icon appears in the start screen.

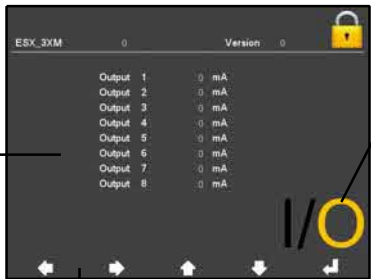
14.4.5.4 Menu controls inputs / outputs

If the menu “controls inputs / outputs” is selected a container appears, in which further sub-menus can be selected.

Menu controls inputs / outputs		
Screen	No.	Description
	1	Control 3XM
	2	Control Safety
	3	Control IOX 1
	4	Control IOX 2
	5	Control IOX 3
	6	Control IOX 4

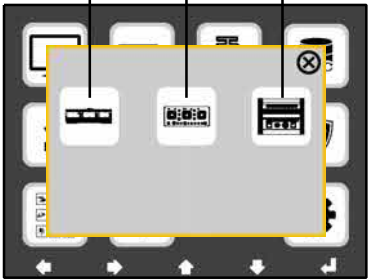
Submenus in the menu controls inputs / outputs

In the submenus, the states of the inputs and outputs of the selected control will be displayed. In the following example, the screens of one control with the corresponding information are displayed.

Submenus in the menu controls inputs / outputs		
Screen	No.	Description
	1	Designation of the control
	2	SAP number of the control
	3	Software version
	4	Raw values of the inputs
	5	Raw values of the outputs
	6	By touching the arrows "next" and "back" all inputs and outputs can be displayed.

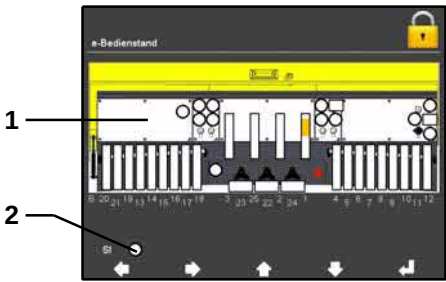
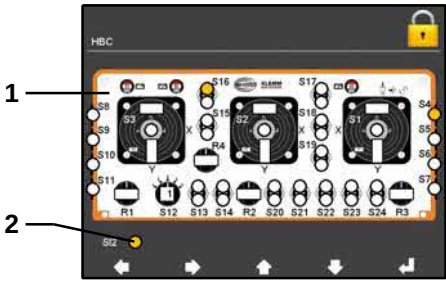
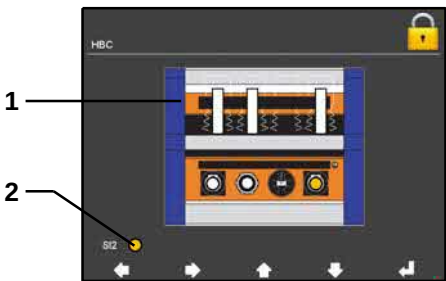
14.4.5.5 Menu operating unit

If the menu "operating unit" is selected a container appears, in which further submenus can be selected.

Menu operating unit		
Screen	No.	Description
	1	Electric control panel
	2	Radio remote control HBC - Spectrum
	3	Radio remote control HBC - Linus

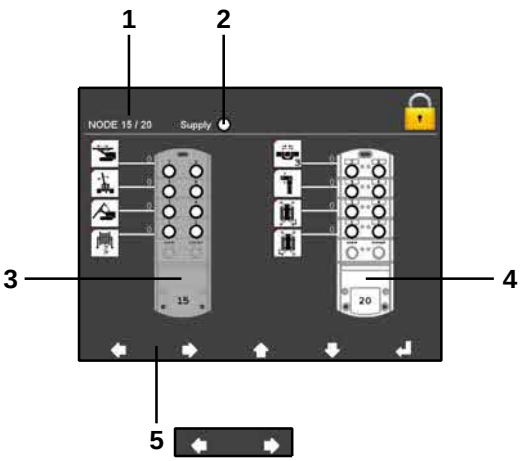
Submenus in the menu operating unit

In the submenus, states of the operating units are displayed.

Submenus in the menu operating unit		
Screen electric control panel	No.	Description
	1	Signals buttons and joysticks
	2	Status safety contact yellow: active (ok) white: not active (error)
Screen radio remote control HBC - Spectrum		
		
Screen radio remote control HBC - Linus		
		

14.4.5.6 Menu CAN-nodes

In the menu “CAN nodes” the following information are displayed.

Menu CAN nodes		
Screen	No.	Description
	1	Displayed nodes
	2	Status power supply yellow: active (ok) white: not active (error)
	3	Current CAN node (grey background) The function for each channel and LED status are displayed. By touching a function, the corresponding function page appears.
	4	Deactivated CAN node (white background)
	5	By touching the arrows “next” and “back” all CAN nodes can be displayed.

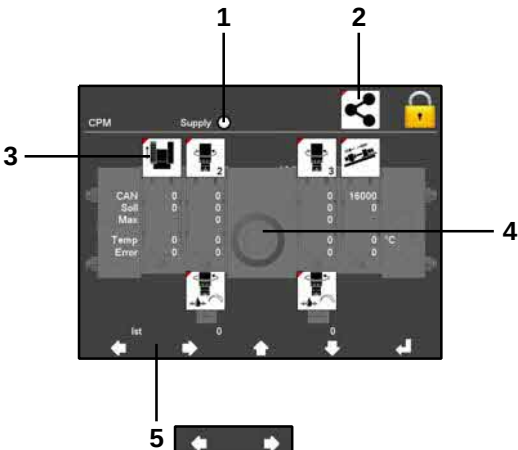
Example of a function page in the menu “CAN nodes”

On the function page, states of various functions of the CAN nodes are displayed. The structure of the function page is similar for all functions.

Example function page „drill mast displacement“		
Screen	No.	Description
	1	State of the safety device Touching the icon takes you to the menu “safety device” (see chapter 14.4.5.8 on page 154).
	2	Status safety contact actual view: active (ok)
	3	Status power supply ● yellow = active (ok) ○ white = not active (error)
		Release function
		○ Function active (ok) ⊗ Function not active (error)
	4	Output of the function Bar = deflection piston control block
	5	Status safety contact actual view: not active (error)
	6	By touching the arrows “next” and “back” all functions can be displayed.
	7	Function at the electric control panel Bar = deflection of the joystick
	8	Function at the radio remote control Bar = deflection of the joystick
	9	Status radio remote control activated = symbol yellow deactivated = symbol black

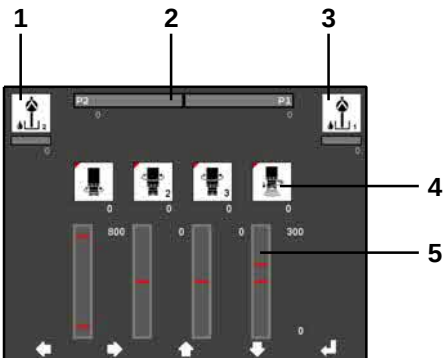
14.4.5.7 Menu electric control blocks

In the menu “electric control blocks” the following information are displayed.

Menu electric control blocks		
Screen	No.	Description
	1	Status power supply yellow: active (ok) white: not active (error)
	2	Distribution volume flow By touching, the function page “distribution volume flow” is displayed.
	3	Functions By touching of a function, the corresponding function page is displayed (example of a function page in chapter 14.4.5.9).
	4	Raw values of the solenoid valves
	5	By touching the arrows “next” and “back” all CAN valves can be displayed.

Function page “distribution volume flow” in the menu “electric control blocks”

On the function page, states of the selected control block are displayed.

Function page “distribution volume flow”		
Screen	No.	Description
	1	Activation of pump 2 (raw value)
	2	Power sharing between pump 1 and pump 2
	3	Activation of pump 1 (raw value)
	4	Functions / Valves for summing By touching of a function, the corresponding function page is displayed (example of a function page in chapter 14.4.5.9).
	5	Volume flow distribution The bar graphs show the distribution of the volume flow, and the current maximum values (raw values).

14.4.5.8 Menu safety device

In the menu “safety device” the states and settings of the safety device are displayed.

Menu safety device		
Screen	No.	Description
	1	Status safety system displays the status of the safety system (ok / fault)
	2	Working configuration Selection and indication of the current working configuration. By touching the touch-icon, the menu “selection of the working configuration” ap- pears (see page 134).
	3	State of clamping jaws opened / closed
	4	State safety guard Status safety contacts Status locking pin
	5	Mode indication drilling / driving / alignment / magazine
	6	Position of operation mode selector switch OFF / ROM / SPM
	7	Status contacts pull switch (ok / fault)
	8	Operation mode shows the resulting e.g. current operation mode
	9	Interval request of working configuration Adjustable from 1-10 days. By touching the interval icon, a keypad ap- pears. The intervall can be entered and confirmed over the keypad.
	10	Status LED blue (signal tower) off on / flashing
	11	Status LED yellow (signal tower) off on / flashing
	12	Reduced speed active not active
	13	Hold-to-run function active not active

14.4.5.9 Menu functions

In the menu “functions” the selectable functions of the equipment are displayed.

Menu functions		
Screen	No.	Description
1 — 	1	By touching of a function, the function page of the corresponding function appears.

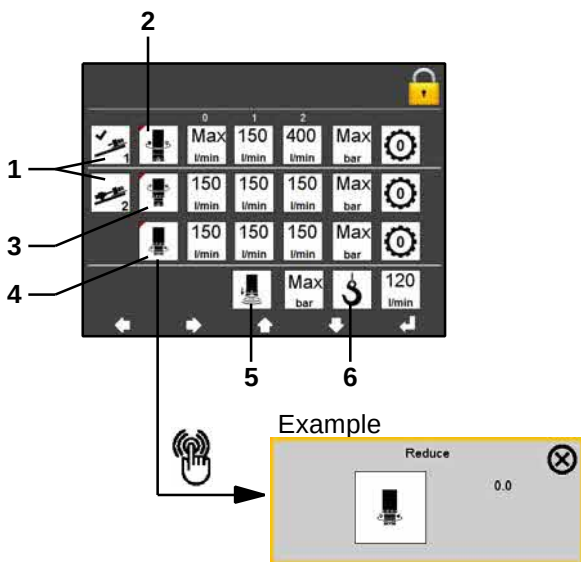
Example of a function page in the menu “functions”

On the function page, states of various functions are displayed. The structure of the function page is similar for all functions.

Example function page „inner rotation“		
Screen	No.	Description
	1	State of the safety device Touching the icon takes you to the menu “safety device” (see chapter 14.4.5.8 on page 154).
	2	Valve pressure inner rotation Bar = adjustment of the valve
	3	Status safety contact radio remote control actual view: active
	4	Status power supply yellow = active (ok) white = not active (error) Release function Function active (ok) Function not active (error)
	5	Valve inner rotation Bar = deflection of the valve Release valve (actual view = not active)
	6	Status safety contact electric control panel actual view: not active
	7	Number of selected gear stages
	8	By touching the arrows “next” and “back” all functions can be displayed.
	9	Function at the electric control panel Bar = deflection of the joystick
	10	Pre-adjustment inner rotation at the electric control panel Bar = adjustment of the pre-adjustment
	11	Function at the radio remote control Bar = deflection of the joystick
	12	Status radio remote control activated = symbol yellow deactivated = symbol black
	13	Pressure regulation inner rotation (electric control box at the base unit Bar = adjustment of the potentiometer)

14.4.5.10 Menu system parameters

In the menu “system parameters” the following information are displayed.

Menu system parameters		
Screen	No.	Description
	1	Number of drill heads One drill head or double drill head unit
	2	Settings drill head (one drill head) Volume flow (-- series, parallel), pressure, gear stages. By touching the icon, a container appears in the display (see example). Here the value of the function reduction in the modes SPM and ROM can be read.
	3	Settings drill head (double drill head unit - inner drill string rotation) Volume flow, pressure, gear stages. By touching the icon, a container appears in the display (see example). Here the value of the function reduction in the modes SPM and ROM can be read.
	4	Settings drill head (double drill head unit - outer drill string rotation) Volume flow, pressure, gear stages. By touching the icon, a container appears in the display (see example). Here the value of the function reduction in the modes SPM and ROM can be read.
	5	Settings drifter percussion
	6	Settings crane volume flow

14.4.6 Engine Management System (EMS)

EMS is an electronic system with CAN communication (Controller Area Network) for diesel engine control. The system has been developed by Volvo Penta and includes fuel regulation and diagnostic functions. The system consists of a control unit, injectors, a number of sensors that supply the control unit with information, and connectors for diagnostics and functional checks. The engine can be connected to a communication interface comprising a CAN link and a serial link.

For more information, refer to the documentation of the engine manufacturer!

14.4.6.1 References to engines with Engine Management System (EMS)

NOTICE

Risk of causing damage to the engine control system!

To shut down the engine, the engine control must be shut down with the ignition key. The battery main switch may only be switched off after the control unit lag time is over.

The lag time is the time in which the control unit saves necessary data (such as logistical data, error memory, etc.) in the EMS. It lasts a maximum of 2 minutes.

If this lag time is interrupted, the following errors are possible:

If the engine is shut down by using the battery disconnecting switch, important operating data are not stored and an engine error can occur.

For this information, the following instruction pictogram is stuck on the equipment:



Electrical welding

In order to prevent damage when carrying out ELECTRIC welding of the installation, the plug connections of the EMR and ESX-calculator shall first be pulled out! They are located at the left hand side of the Diesel engine inside the sound proof cover.

The ignition must be switched off when working on the EMR.

Remove plug

Removing the 25-pole control apparatus plug when the control apparatus is on, i.e. when the voltage supply is on is not permitted.

1. Voltage supply off
- only then -
2. pull out plug

Damages

The plug connections of the control units are only dust and watertight when plugged into mating connection! Until the mating connector has been plugged in, the control units must be protected against spray water!

14.4.6.2 References to the Exhaust Aftertreatment System (EATS)

NOTICE**Risk of causing damage to the Exhaust Aftertreatment System**

Should any AdBlue®/DEF solution remain in the hoses in freezing weather, the entire system can be damaged. To avoid this and any solution spillage, the system is equipped with automatic drainage when the engine is switched off so that hoses, the pump and injector are emptied and the solution runs back to the tank.

The automatic drainage does not work, if the engine power supply is disconnected!

Do not switch off the battery main switch before the system is drained properly!

For this information, the following instruction pictogram is stucked on the equipment:



For more information, refer to the documentation of the engine manufacturer.

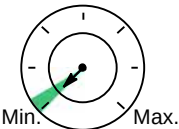
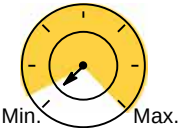
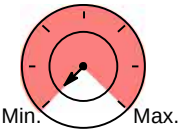
14.5 EEP-assist

OPTION - EEP (Energie Effizienz Paket - Energy efficient power)

In the EEP system several measures are combined and matched to increase the energy efficiency. By this, a significant increase in efficiency and hence productivity is achieved. These measures include e.g. short hydraulic lines with large cross-section, parallel hydraulic valves for handling large volume flows, Power Sharing and also EEP-assist.

EEP-assist has an impact on the speed of the diesel engine. The aim is to reduce fuel consumption and to minimize noise emissions. EEP-assist can be operated in the modes „adaptive“ and „preset“. To encourage the environmentally-conscious user behaviour, one of these modes is preset.

Upon request, the system can be deactivated by the operator.

Function description EEP-assist			
Operation mode	Setting at the display	Positioning of the potentiometers for engine speed adjustment	Effect / function
adaptive			The engine speed is calculated based on the required amount of oil or hydraulic power and set automatically. If the required amount of oil or power reduces, the engine speed is automatically reduced with a delay.
preset			The engine speed is preset by the operator. If a function is activated, the engine speed is adjusted to the preset value. If no function is activated, the engine speed is automatically reduced with a delay.
off			The engine speed is set by the operator.

The setting of the optional system EEP-assist at the display of the equipment is described in chapter 14.4.5.3 on page 147.

14.6 Operation mode optimized pump power adjustment (Power Sharing)

The drill rig is equipped with a operation mode optimized pump power adjustment (Power Sharing) for the two main hydraulic pumps. That means, that the possible total power take-off can be distributed to different percentages to the two hydraulic pumps.

The operation mode optimized pump power adjustment (Power Sharing) can operate in three different modes, which can be set via the display of the engine monitoring box.

Setting Power Sharing:

OFF: The power is distributed evenly to the pumps P1 and P2.

ON: The power can be manually distributed to the pumps P1 and P2.
Regulation by a potentiometer at the control box at the base unit - see chapter 14.14 from page 200.

AUTO: The power is distributed on the pumps P1 and P2 automatically as needed.

The power take-off for the pump 1 and 2 is adjustable as follows:

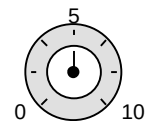
Flywheel power

Possible power take-off 140 kW

Power sharing
50% / 50%

Pump 1
(outer drill string rotation)
70 kW

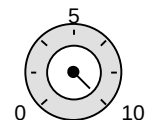
Pump 2
(inner drill string rotation)
70 kW



Power sharing

Pump 1
(outer drill string rotation)
100 kW

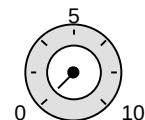
Pump 2
40 kW



Power sharing

Pump 1
40 kW

Pump 2
(inner drill string rotation)
100 kW

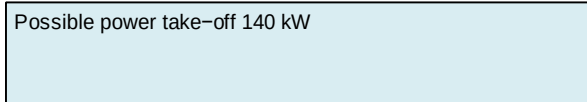


Function assignment of the pumps 1 and 2

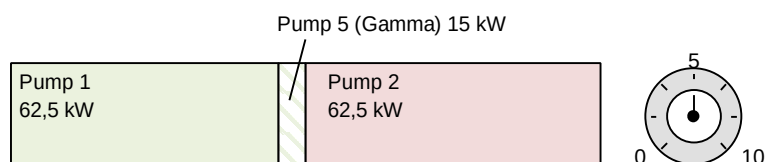
Pump 1	Pump 2
Outer drill string rotation left/right	Inner drill string rotation left/right
Rapid feed forward/backward	Crane / Additional consumer (option)
Additional consumer A/B (option)	

If the optional mounted water pump Gamma is switched on during operation of the drill rig, the power of the pumps 1 and 2 is reduced by the needed power for the operation of the pump 5. In this case, the possible power take-off for the pump 1 and 2 is adjustable as follows:

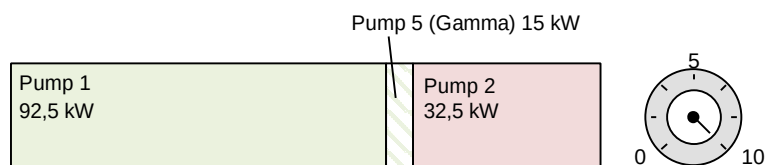
Flywheel power



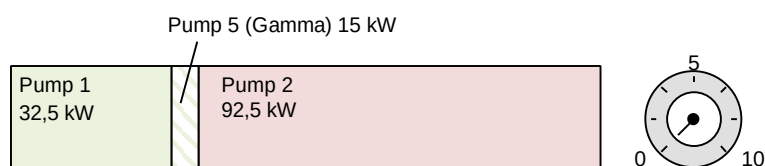
Power sharing
50% / 50%
+ Gamma Pump



Power sharing
+ Gamma Pump



Power sharing
+ Gamma Pump



Example of a rational use of POWER SHARING

Overburden drilling with double head unit

(Rotation/rotation/percussion: inner and outer drill rod):

1. Drilling with double head unit
(rotation/rotation/percussion) POWER SHARING Level 5
2. Set down the outer drill rod (casing)
3. Continue drilling with inner drill rod only POWER SHARING Level 0
4. Pull the inner drill rod POWER SHARING Level 5
5. Pull the outer drill rod (casing) POWER SHARING Level 10



Depending on the used power, the engine speed can be reduced. For example in operation phases, in which not all consumers of the drill rig are used at the same time. As a result, the fuel consumption can be reduced.

14.7 Driving the equipment

**WARNING**

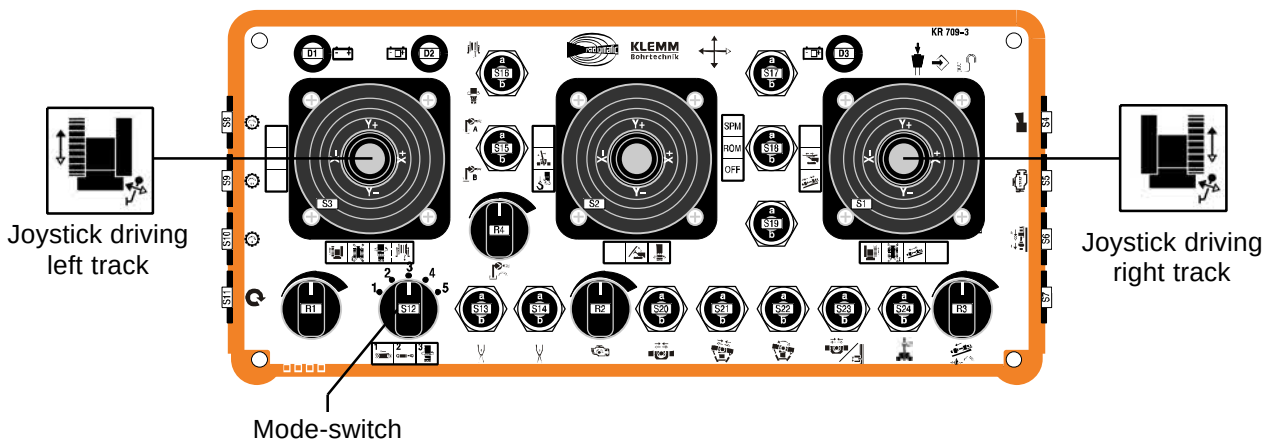
Danger of accident!

When driving the equipment under non permitted conditions, the equipment can carry out uncontrolled movements. This can lead to serious or fatal accidents for persons.

Δ Safety instructions in Chapter “Safety” must always be observed.



Driving the equipment is only possible, if the mode-switch at the remote control is switched in driving mode.



Activate control levers 1 + 2 in corresponding direction. Do not adjust levers with full stroke to begin driving, but activate as if accelerating a car. Lever position determines the degree of opening of the control valves, and therewith the quantity of oil supplied. When throttled diesel engine, the driving speed is not reduced.

Steering the equipment is achieved by opposite switching of the control levers. Turning and/or change of direction of the equipment always by using of both track chains. Do never use only one track chain and do not drag the second track chain behind.

By zeroing the control levers, the the tracks are automatically braked.

14.7.1 Manoevrability

To ensure maximum manoevrability and steering of the crawler tracks, it is important to keep the track chains clean and free from build ups. Dirt and mud build up in the crawler tracks make the chain stiff and difficult to pass over the sprockets. This impairs the steering capacity and may cause ruptures and breakages of the crawler chains.

14.8 Operation control systems electrically controlled equipment

KLEMM Bohrtechnik offers two control variants for electrically controlled equipment:

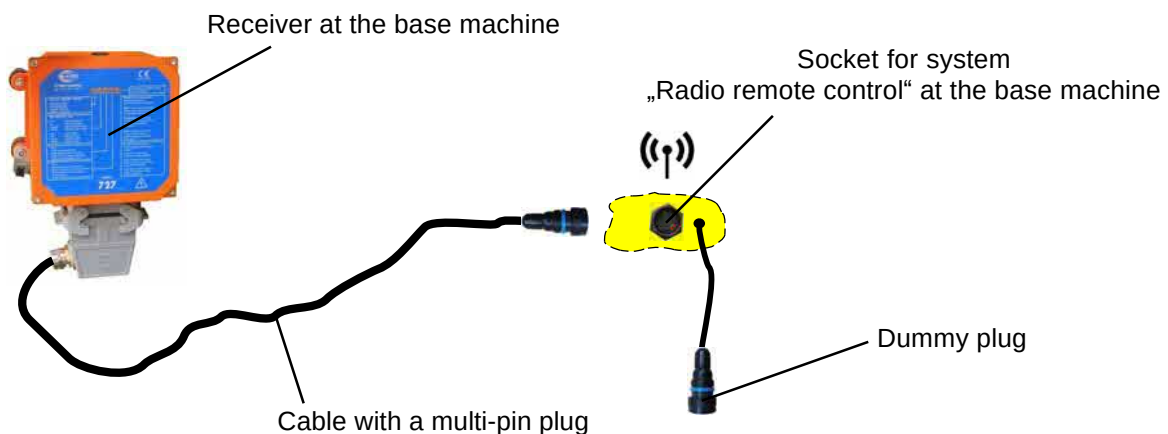
- Radio remote control
- Electric control panel

Electrically controlled equipment can be optionally fitted with one of the control systems or with both systems.

Both systems are connected separately to the base machine.

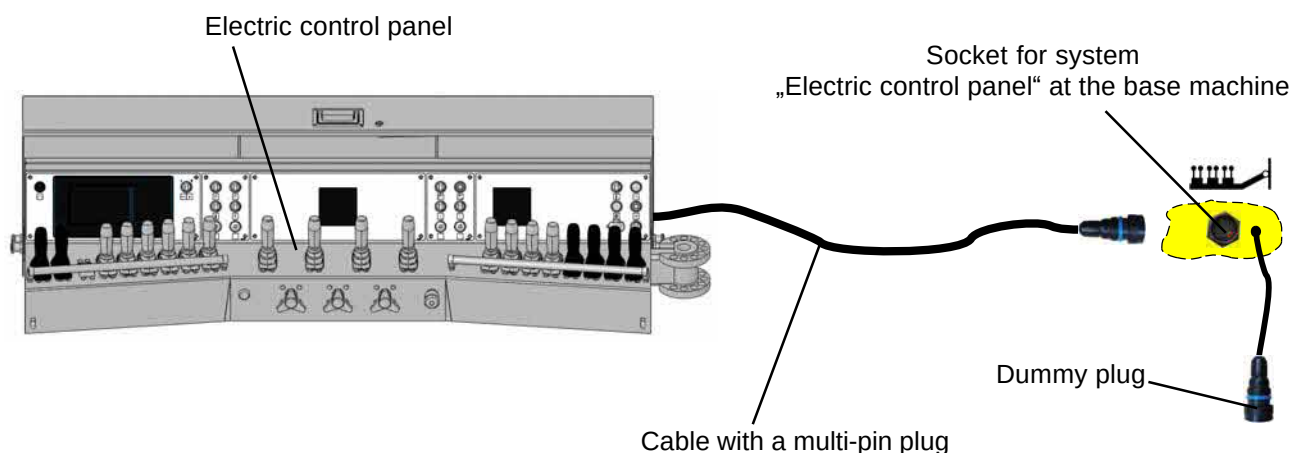
In the system "Radio remote control" a cable with a multi-pin plug is connected to the receiver of the radio remote control. For operation of the radio remote control, the multi-pin plug must be connected to a socket at the base machine, which is nearby the receiver.

System "Radio remote control"



In the system "Electric control panel" a cable with a multi-pin plug is connected to the electric control panel. For operation of the electric control panel, the multi-pin plug must be connected to a socket at the base machine, which is nearby the electric control panel.

System "Electric control panel"





Regardless of the installed control system, the equipment is fitted with the socket for connection of the radio remote control and with the socket for connection of the electric control panel. At both sockets a dummy plug is installed. The dummy plug must be connected to the socket if the corresponding control system is not installed or not used. If the dummy plug is not connected to the free socket, the equipment can not be started!



Danger of accident!

Both operating control systems are equipped with a emergency-stop safety device. Safety equipment and protective equipment that is installed at the equipment must be fully functional.

If a installed operating control system is not activated, the emergency-stop safety device is not working. Because of this reason the access to this operating control system must be excluded.

Non-observance of the following references can lead to serious or fatal accidents for persons.

- Δ If the system „radio remote control“ is not activated, the access to the radio remote control must be excluded. The radio remote control must be stored out of reach of the operating personnel.
- Δ If the system „electric control panel“ is not activated, the access to the operating elements of the control panel must be excluded. The cover of the electric control panel must be closed and locked or the electric control panel must be dismantled from the equipment.

14.8.1 Start of electrically controlled equipment

1. System Radio remote control

If only the system "Radio remote control" is installed, the start sequence, which is described in the corresponding chapter to the radio remote control, must be observed. The socket for the control system "Electric control panel" at the base machine must be fitted with the corresponding dummy plug.

2. System Electric control panel

If only the system "Electric control panel" is installed, the device can be started by the start button at the electric control panel after switching on the engine monitoring. The socket for the control system "Radio remote control" at the base machine must be fitted with the corresponding dummy plug.

3. System Radio remote control and Electric control panel

If both systems are installed, the equipment can be started via the radio remote control as described in point one.

If the equipment should be started via the start button of the electric control panel, the start sequence of the radio remote control must be carried out until the actual start of the equipment. If only one of the both installed systems is used, the not used system can be deactivated by disconnecting the cable with multi-pin plug from the corresponding socket and connecting of the dummy plug.

Then, the equipment can be started as described for the corresponding system under point 1 or 2.

If the radio remote control system is deactivated, it is not longer necessary to carry out the start sequence of the radio remote control when you start the equipment via the electric control panel.

Further information on the operation of the control systems can be found in the optional descriptions of the control systems.

14.9 Operation of alignment and drilling via radio remote control

14.9.1 Radio remote control of the drill rig KR 709-3G

14.9.1.1 General

Safety Instructions

Read through these operating instructions carefully before working with the radio system. This applies in particular to the installation, commissioning and maintenance of the radio system. The operating instructions are a constituent part of the radio control system and must always be kept close at hand for the responsible personnel.

The term "machine" is used in the operating instructions for the different possible uses of the radio system.

Intended Use

The radio system serves to control machines and for data transfer. Observe the job safety and accident prevention regulations applicable to each application.

The intended use also includes reading the operating instructions and adhering to all safety information contained therein.

The radio system must not be used in areas where there is a risk of explosion, nor for the control of machines used to convey persons, unless it is explicitly approved by the manufacturer for these uses.

Modifications to the radio system may only be carried out by specialist personnel who have been trained and authorized by HBC-radiomatic. All modifications must be documented at the factory in the radio control master file.

The radio control system safety devices must not be modified, removed or bypassed. In particular, modifications to any part of the radio system's complete E-STOP system are impermissible.

Safety Instructions for Installation and Operation

The electrical connection per the accompanying output wiring diagram must be established by a qualified electrician exclusively.

The receiver may only be opened by trained personnel. Components inside the receiver can be energized at life-threatening voltages. The supply voltage for the machine must be deactivated before the receiver is opened.

Please also note with radio systems, that the presence of persons in the danger zone - in particular beneath the load (cranes!) - is prohibited in every instance.

Select a safe location for radio control, from which you have a good and complete view of the working movements of the machine, the load movements and the surrounding working conditions.

It is not permissible to put a radio transmitter unattended to one side whilst activated. Always switch the radio transmitter off when it is not required. This applies in particular if you change location, when working without radio control, during breaks and at the end of work. Always safeguard the radio transmitter against use by unauthorized persons, for example by locking it away.

In the event of an emergency and with all faults, switch the radio transmitter off immediately by pressing the STOP switch.

Only operate the radio system when it is in perfect working order. Faults and defects that could influence safety must be rectified before the system is put back into operation, by specialists who have been trained and authorized by HBC-radiomatic.

Note that the operational directions of the operating elements may appear inverted depending on location and viewing angle to the machine. This applies in particular to rotary cranes, if your location changes from inside to outside the radius of the crane. The operator must make himself familiar with the directional markings on the machine before the start of work.

Repairs may only be carried out by specialist personnel who have been trained and authorized by HBC-radiomatic. Use original replacement parts and accessories (e.g. rechargeable batteries) exclusively; otherwise it is possible that the equipment safety can no longer be guaranteed and our extended warranty will be voided.

Remain vigilant when working with the radio system and familiarize yourself with its functions. This applies in particular if you are working with it for the first time or if you work with it only occasionally.

Check each time before starting work the function of the STOP switch.

When you press the STOP switch with the transmitter on, the status LED of the transmitter has to go out. If the status LED does not go out then you have to disable the radio control system immediately.

Remove the battery and the radiomatic®iON/iLOG from the transmitter and inform a service technician.

Operation

The transmitter is equipped with an electronic radiomatic®iON or iLOG key. radiomatic®iON/iLOG contains all the data required for operating the transmitter. Operation is not possible without radiomatic®iON/iLOG!

When activating the transmitter and if the radio connection is interrupted (e. g. if the connection is lost or the transmission range is exceeded), the transmitter reacts with the so-called enforced zero-position.

Release all operating elements so they can return to the zero-position and actuate the Start-button. The machine will not react if the operating elements are not in zero-position. This prevents uncontrolled machine movements after the radio connection has been interrupted.

Battery and Battery Charger

Li-ion Battery

The battery capacity (= the amount of electric current that can be stored) and the battery charge (= the actual amount of stored current) depend on the age of the battery and the environment temperature. If the temperatures are below 0 °C (32 °F) or above 40 °C (104 °F), less current can be retrieved.



Danger of accident!

Please adhere to the following safety notifications in all cases. When the Li-ion battery is improperly handled, there is the risk of explosion and of fire. This could lead to life-threatening injuries that might result in death under specific circumstances.

- Δ Use the batteries only in connection with the designated devices.
- Δ Never use or charge damaged or faulty batteries.
- Δ Do not throw the batteries into a fire, short-circuit, damage, or open them. Always use the protective cap provided in the accessory to store the battery.
- Δ Charge the battery fully before storing it for a prolonged period. Otherwise total discharge of the battery may occur. Please note the date code on the battery.
- Δ Use only the associated HBC charger to charge the battery.
- Δ Charge the battery at an ambient temperature of 0 – 45 °C (32 – 113 °F).
- Δ Do not expose the batteries to direct sunlight.
- Δ The batteries have to be recycled or disposed of properly.

Notes:

In all cases, charge the batteries completely before initial use. This ensures that the batteries have their full capacity in use.

Store the batteries at -15 – +35 °C (5 – 95 °F).

Charge the batteries at intervals not exceeding 3 months when they are stored.

When handled properly, Li-ion batteries by HBC-radiomatic can reach up to 500 charging cycles. Even after that, your batteries can be used for some time with a slightly decreased capacity.

Battery Charger

Depending on customer selection, an AC or DC charger is available. A connection cable with the appropriate plug is included in the delivery.



Danger of accident!

Please adhere to the following safety notifications in all cases. When the charger is improperly handled, there is the risk of fire and of electrical shock. This could lead to life-threatening injuries that might result in death under specific circumstances.

- Δ Use this charger only to charge the batteries specified on the type plate.
- Δ The charger may not be used in hazardous areas or in the vicinity of flammable materials.
- Δ The charger has to be operated with the voltage indicated on the back.
- Δ The charger has to be used in vehicles or indoors only.
- Δ Use the charger only within the specified temperature range of 0 – 45 °C (32 – 113 °F).
- Δ Protect the charger against heat, dust and humidity.
- Δ Do not cover the charger while it is in use.
- Δ Disconnect the charger from the power supply when it is not in use.
- Δ In case of any fault of the charger or the connecting cable disconnect it immediately and put it out of operation.
- Δ Do not make technical changes to the charger or the connecting cable.

Maintenance and servicing:

Disconnect the plug before cleaning the charger.

Make sure that the contacts of the charger and the battery pack are free from dirt in order to ensure a faultless functioning of the charger.

Charging the battery:

1. Connect the charger via the connecting cable to the power supply.
2. Insert the battery into the compartment.

Charging will start automatically.

Display:

Three LEDs indicate the actual operating state of the battery.

LED green: Illuminates when battery is charged.

LED orange: Illuminates when battery is charging.

LED red: Illuminates when battery is defective.

Flashes when the battery temperatures are below 0 °C (32 °F) or above 45 °C (113 °F). The battery is not charged in this case.

Technical Data QA401600 / QD401300	
Operating voltage	100 – 240 V AC (QA401600) 10 – 30 V DC (QD401300)
Charging time	< 4 h
Operating temperature	0 – 45 °C
Housing material	Plastic
Protection class	II
Charging method	CC/CV
End of charging voltage	4,2 V

Option Internal Battery

In order to ensure an uninterrupted operation when the battery is being replaced, the transmitter is equipped with an internal battery. When the external battery needs to be replaced, the transmitter is supplied by the internal battery.

The internal battery is automatically charged during the radio operation when needed.

Battery and charging status indication

Indication		Meaning
	Gleams green	The transmitter is supplied by the external battery.
	Blinks red	The transmitter is supplied by the internal battery. The external battery needs to be replaced.
	Gleams red	The transmitter is supplied by the internal battery. There is no external battery inserted.
	Off	The internal battery is not (completely) charged and is not being charged at the moment.
	Gleams orange	The internal battery is being charged.
	Gleams green	The internal battery is completely charged.
	Blinks red	The temperature of the internal battery is below 0°C or above 45°C. The charging process has been interrupted.

Display

Field strength

The field strength indication provides information about the quality of the radio connection. With an optimum connection, all 5 bars are displayed. The field strength indication is always visible when the transmitter is turned on.

Field strength is indicated in the following degrees:



Strong received signal.



Weak received signal.



No signal.

Note:

If  symbol is displayed the risk of the radio connection being interrupted is imminent. Ensure that the radio connection is not impaired by an obstacle (e.g. a building) and ensure that you are within the range of the radio system. It may be necessary to change the working position.

Battery

The battery indication provides information about the current condition of the battery. It is always visible when the transmitter is turned on.

The battery status is displayed in the following degrees:



The battery is charged.



Pre-warning: The battery needs to be charged soon.



The battery needs to be charged. The status LED in the transmitter flashes red and an acoustic signal sounds. Exchange the battery. Otherwise, the transmitter will switch off in a few minutes. Recharge the empty battery in the respective charger.

Options

The availability of the following functions depends on the design and configuration of your radio control system.

Safety Features

radiomatic®shock-off / zero-g / inclination switch

In specific emergency situations, these safety features can prevent unintended movement commands from being given to the machine, protecting the operator as well as other personnel in close proximity to the machine in use.

radiomatic®shock-off can react if the transmitter receives a hard impact.

radiomatic®zero-g can react if the transmitter is falling down or being thrown.

inclination switch can activate if the transmitter exceeds an inclination angle of approx. 45° for a specified time and/or is positioned upside down.

Depending on the ordered version the features can operate in three different ways:

All functions that can be operated by the radio remote control are deactivated.

The diesel engine of the drill rig still runs and a acoustic signal will be activated.

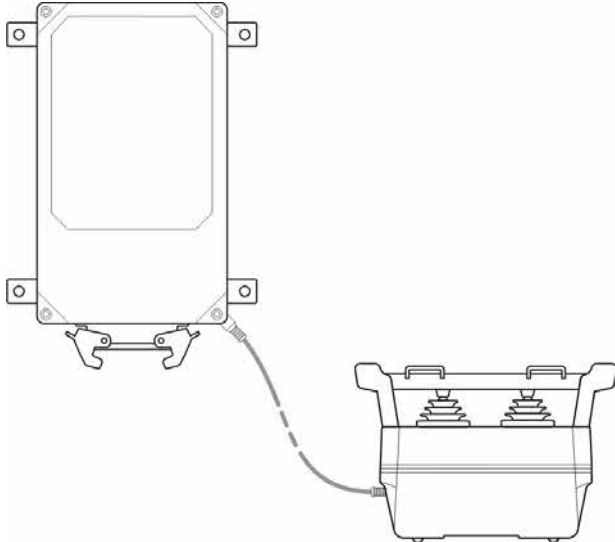
To deactivate the features, press the Start button until the status LED flashes green. Then the transmitter is ready to operate again.

Note:

The safety features do not relieve the operator of his responsibility to turn off the transmitter with the STOP switch when not in use.

Cable Control

With a cable you can generate a direct data connection between the transmitter and receiver. The radio transmission is disabled. At the same time, the power supply of the transmitter is provided through the cable, as well.



Connecting the cable

1. Switch the transmitter off.
2. Remove the screw lock on the transmitter and receiver.
3. Connect the transmitter and the receiver with the cable.
Ensure that the connector is locked.
4. Switch the transmitter on.

Notes:

If you connect the cable while working with the system, the transmitter will switch off automatically. Actuate the start button to switch to cable operation.

When the system is in cable mode the transmitter will receive the supply voltage from the receiver, i.e. the transmitter can be used without the battery.

If you disconnect the cable from the transmitter and receiver, the system will switch off automatically. Actuate the start button to switch back to radio operation.

Battery will not charge.

Troubleshooting

Note: Please check the functions using the cable control first!

Problem	Possible Cause	Remedy
Transmitter does not react when switched on.	- No power.	- Check battery contacts for damage or contamination. - Insert a fully charged battery into the battery compartment. - Recharge battery.
Low-power indication after minimal operating time.	- Battery contacts are contaminated or damaged. - Battery not charged. - Battery defective.	- Check battery contacts for damage or contamination. - Recharge battery. - Ensure that recharging process runs correctly. - Check transmitter functions using a fully charged or replacement battery.
The display in the transmitter flashes green but it is not possible to effect control commands.	- Receiver has no voltage. - No radio communication.	- Check the connecting cable to the receiver. - Check the functions via the LEDs in the radio status panel of the receiver.
Some commands are not carried out.	- Receiver defective. - Interruption in the connecting cable to the machine.	- Check if all connecting cables and cable junctions are tight.

If none of the measures mentioned resolve the problem, then please contact your service technician, dealer or HBC-radiomatic GmbH.

Maintenance

The radio control system is virtually maintenance-free. Please observe the following points:

Check the STOP switch functionality at regular intervals. Dirt deposits on the switch can hinder the mechanism and impair the function.

Check the rubber bellows or rubber seals of the operating elements at regular intervals for leaktightness. Replace immediately if cracks appear since the penetration of dirt and humidity may damage the function of the operating elements.

Never use a high-pressure cleaner or sharp or pointed objects to clean the transmitter.

Charge and discharge transmitter batteries regularly.

Inspection

Before each start of work, but at least once a day, carry out a visual check for dirt or any possible damages.

CAUTION

In case of a defect, working with the radio control system is not permissible!

Do not try to intervene into the electronic of the radio system by yourself.

Otherwise we must reject any warranty claims.

In case of a defect, please contact the service department of KLEMM Bohrtechnik.

14.9.1.2 Switch on the receiver

The drill rig is equipped with a radio controlled CAN-bus-system. By switching on the engine monitoring of the drill rig, the receiver is powered.

The radio module (Module Focus D) is connected to the radio receiver by a 5-pin circular connector. The antenna module is equipped with an control-LED.



Control-LED

Besides the cable connection in the base of the module a Duo-LED is installed:

The LED light up red when the module is under operating voltage.

The connection to the receiver is made, the internal operating voltage (10 - 30V) is present.

The LED light up green when the transmitter is switched on and the module receives a valid signal on its radio frequency.

14.9.1.3 Switch on and off the radio remote control

Activating the radio remote control (Transmitter)

Transmitter with start sequence:

The steps 4 and 5 need to be carried out within 4 seconds.

1. Insert a charged battery into the battery compartment.
2. Turn the STOP switch to unlock.
3. Switch on the engine monitoring of the drill rig.
4. Shortly actuate the start button and then release. The transmitter will switch off if the button is actuated for longer than half a second!
5. Actuate the start button again until the status LED flashes green. Then release the button. The transmitter is now ready for operation and an acoustic signal sounds.
6. If the drill rig is not yet in operation, the diesel engine can be started by further activation of the start button.

Note:

The transmitter switches off when

- the start button is actuated for longer than half a second (see above, point 4).
- the start sequence (steps 4 and 5) takes over 4 seconds.
- another button is actuated during the start sequence.

You must then repeat steps 4 and 5 or 4 to 6.

Deactivating the radio remote control (Transmitter)

Press the STOP switch.

Note:

Replace the battery when the status LED in the transmitter flashes red, an acoustic signal sounds and the transmitter vibrates (option). Otherwise, the transmitter will switch off in a few minutes.

Recharge the empty battery in the respective charger.

Automatic Switch-Off (APO Function)

For safety reasons we have equipped the transmitter with an automatic switch-off (APO function). The transmitter is automatically put out of circuit after approx. 15 minutes of non-use. The automatic switch-off also saves battery power.

After an automatic switch-off you must reactivate the transmitter as described in chapter "Operation".

Caution:

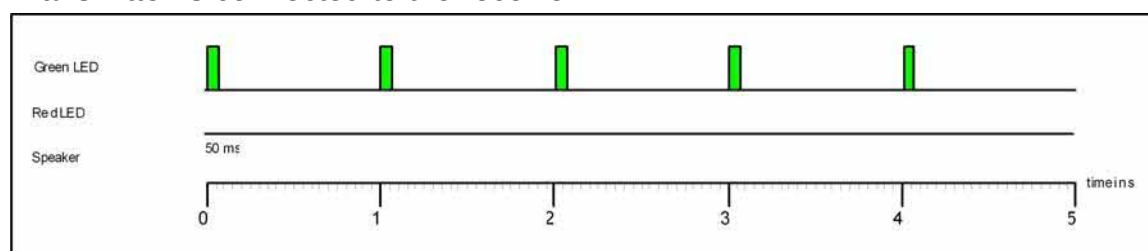
The automatic switch-off does not relieve the operator of his responsibility to turn off the transmitter with the STOP switch when not in use.

Status indications via LEDs and signal tones

You can determine the status of the radio transmitter by means of the blinking states in combination with signal tones. The following statuses can be indicated:

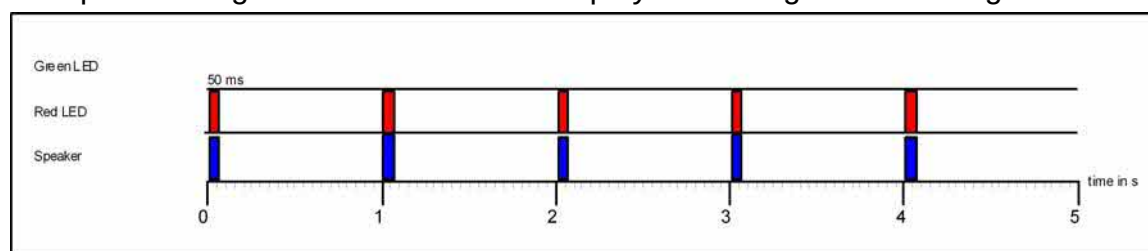
Blinking states and signal tones during operation

Transmitter is connected to the receiver



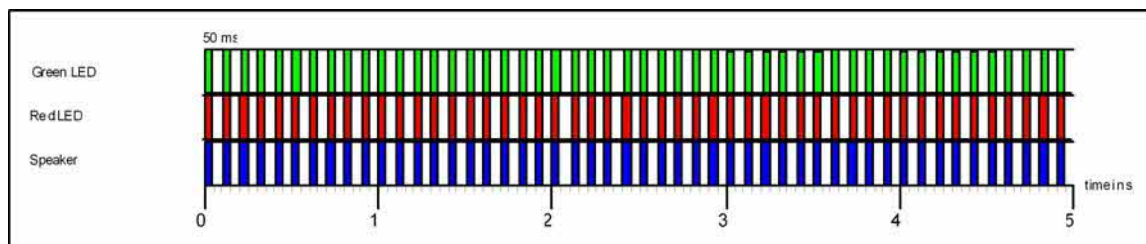
Low voltage pre-warning – transmitter is connected to the receiver.

This pre-warning is also shown in the display of the engine monitoring of the drill rig



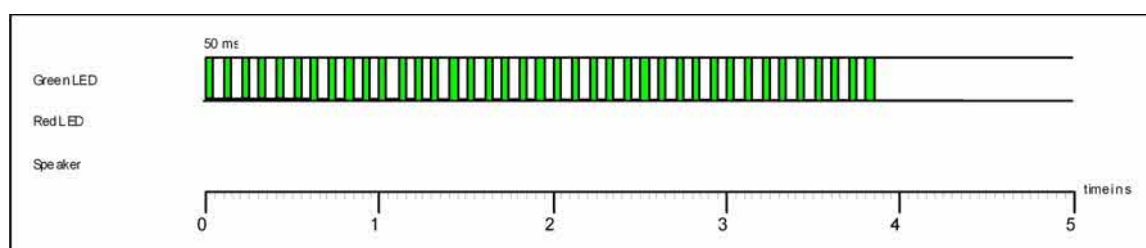
Warning blinking states (optional)

radiomatic® shock-off / zero-g / inclination switch activated

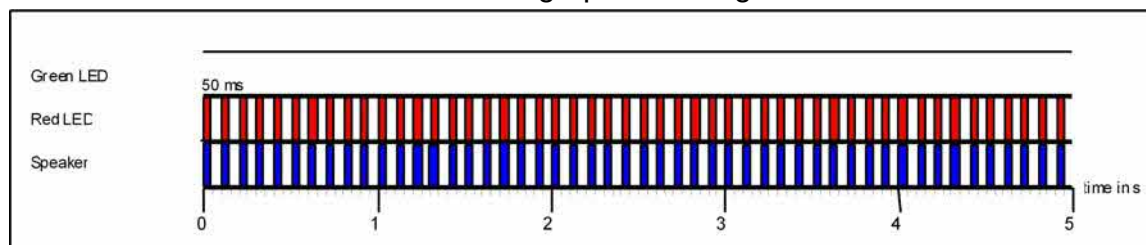


Connection status blinking states

Transmitter is activated – not connected to the receiver.

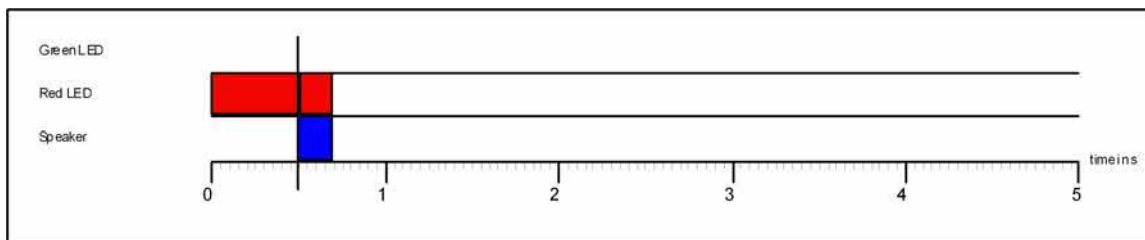


Transmitter is activated and low voltage pre-warning – not connected to the receiver.



Button lock blinking states

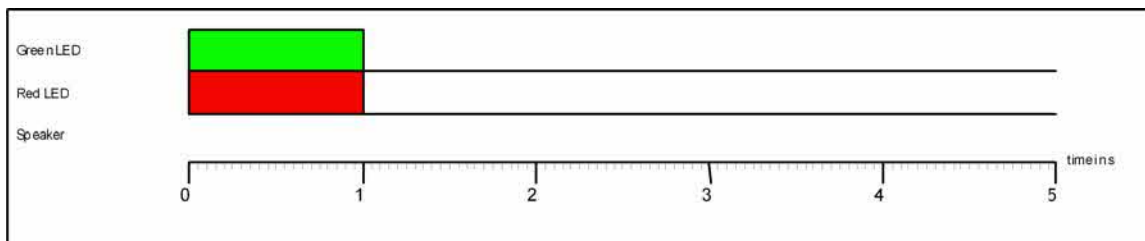
Button lock – button pressed 1 time



Note:

If the button is pressed for more than half a second, a signal tone sounds and the red LED flashes. Then the transmitter will automatically de-activate.

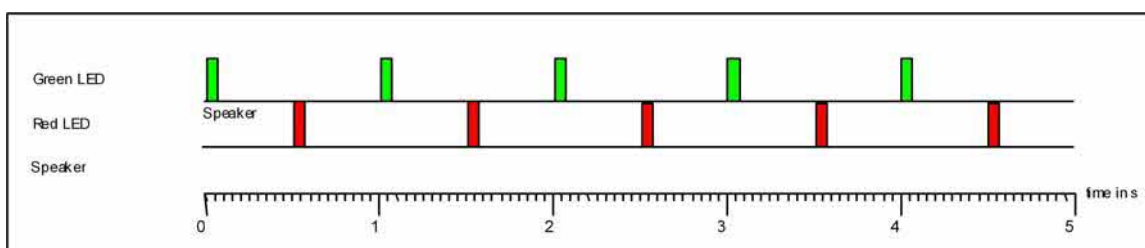
Button lock – button pressed 2 times



Error states

Address error

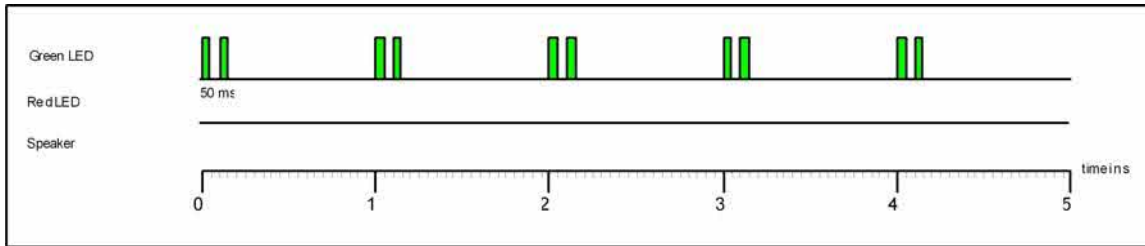
The inverted address does not match the normal filing or a relevant component may be damaged. This error is indicated by the following blinking state:



In this case, please contact our technical support.

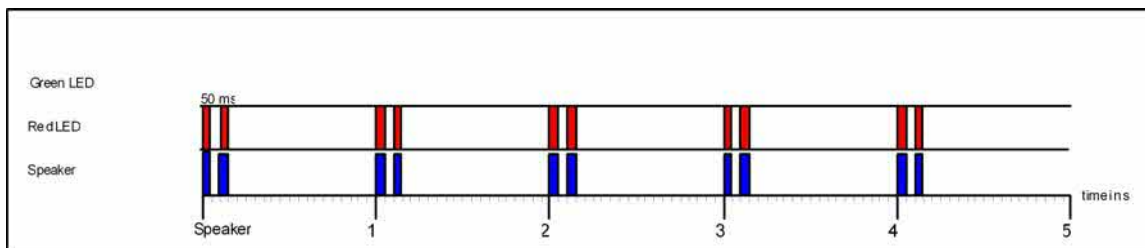
The following blinking states can be indicated:

radiomatic®ADCON cannot be read



In this case, please contact our technical support.

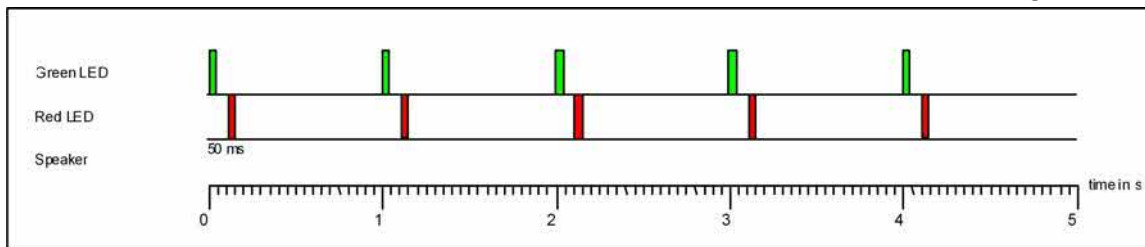
radiomatic®ADCON cannot be read + low voltage pre-warning



In this case, please contact our technical support.

Read-out error radiomatic®iLOG

The radiomatic®iLOG is necessary for the activation of the transmitter. If the information from the radiomatic®iLOG cannot be read, the transmitter shows the following blinking state.



Blinking state "Read-out error radiomatic®iLOG"

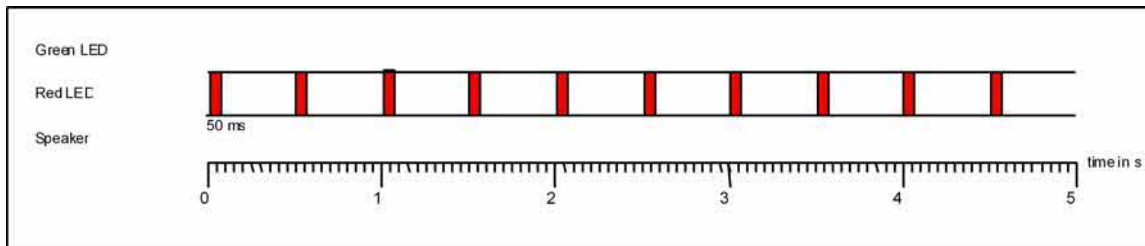
The read-out error can have the following causes:

- The radiomatic®iLOG is damaged.
- The radiomatic®iLOG does not fit to the transmitter or to the radiomatic®ADCON.

In this case, please contact our technical support.

Data set error

There is a data set error if the radiomatic®ADCON contains invalid settings. In this case, the following blinking state occurs:

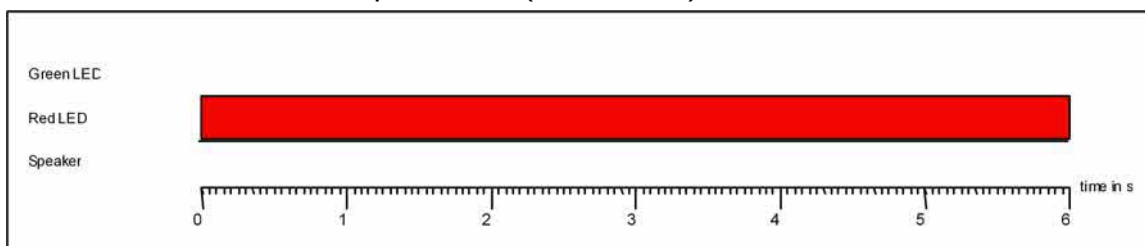


In this case, please contact our technical support.

SI2 error

There is an SI2 error if a button with a safety-relevant function (SI2 function) is activated, defective or mechanically blocked during the start-up of the transmitter. Depending on the configuration of the transmitter, the following blinking states occur:

SI2 error with HBC start-up function (button lock)



In this case, please contact our technical support.

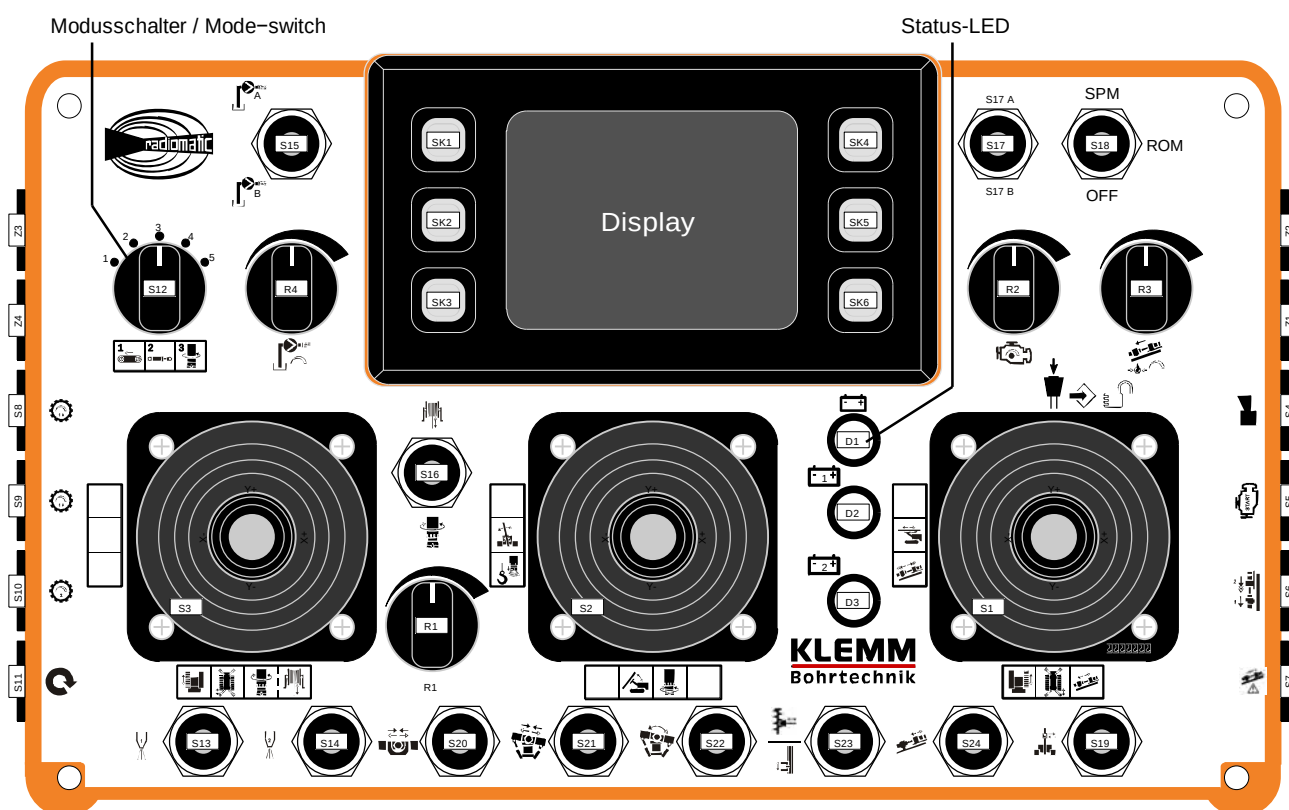
14.9.1.4 Operation of the equipment over the radio remote control

The alignment, drilling and driving functions and other optional functions are controlled via a portable radio remote control. The operator thus has freedom of movement and more options on the jobsite guaranteeing him an optimum view of all working processes.

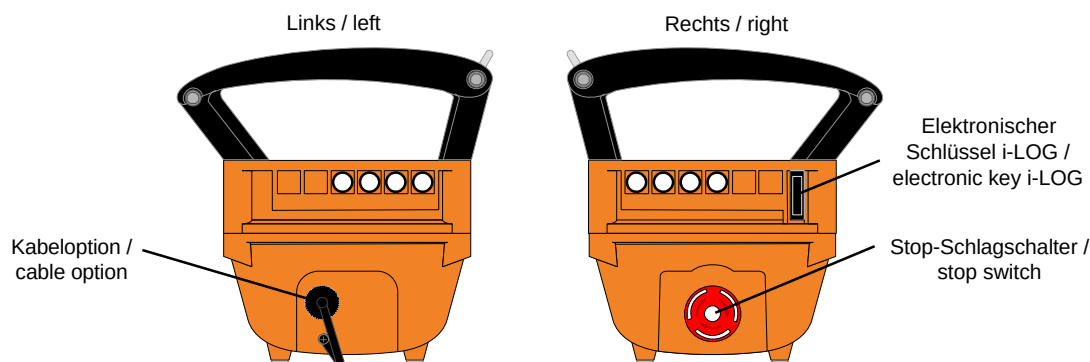
Optionally, this remote control can also be connected to the drill rig via a control cable.

The assignment of the control elements is dependent on the setting of the control mode. By using the mode-switch, you can choose between the operation modes driving, alignment and drilling and other optional modes. On the following pages the assignment of the control elements depending on the selected operation mode are described.

Radio remote control KR 709-3G



Seitenansicht / side view





At the radio remote control of the equipment, an emergency stop switch is installed.
If this stop switch is actuated, the complete drill rig is without voltage.

If the stop switch is defect, working with the equipment is strictly forbidden!



Danger of accident!

The lateral shifting of the glide sledge during drilling operations leads to damages to the equipment and can endanger persons. Persons could be hit by solving components and receive serious or fatal injuries.

Δ During drilling operations, the glide sledge must not be lateral shifted!



Danger of accident!

Drilling operations or any other works with the drill head unit with glide sledge lateral shifted out of the drilling axis can endanger persons. Persons could be hit by solving components and receive serious or fatal injuries.

Δ Drilling operations or any other works with the drill head unit with glide sledge lateral shifted out of the drilling axis are forbidden!

The lateral shifting of the glide sledge is only to be used to open the rope working area of the rope winch in the drilling axis.

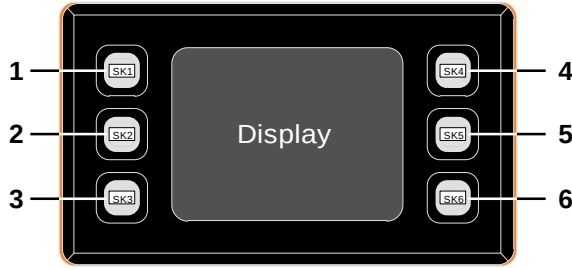


While drilling process the feed pressure can be adjusted steplesly by the potentiometer (pos. R3). The right feed pressure setting depends on ground conditions, drilling diameter and drill hole length, and is reflected by an optimum penetration rate.

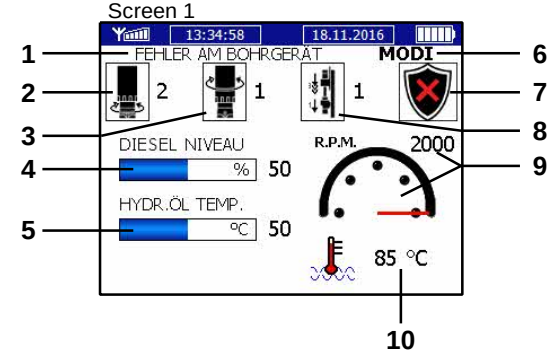
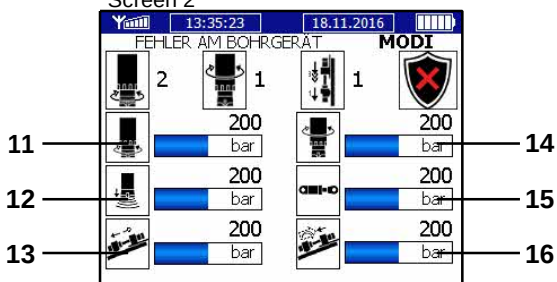
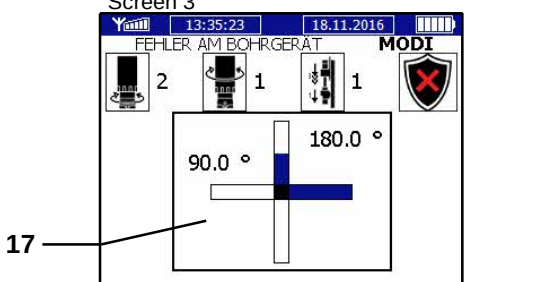


By different tight seals in the clamping cylinders, differences in mobility etc., the synchronisation can be affected unfavorably. In order to reach a synchronisation of the clamping cylinders it is advisable to open and close the clamping devices completely occasionally.

14.9.1.5 Display of the remote control

Display of the remote control		
Display	No.	Description
	SK1	Switching screens 1-3
	SK2	Option
	SK3	Option
	SK4	Option
	SK5	Option
	SK6	Settings Display Remote Control

By the SK1 button, the following screens can be selected.

Display screens		
Screens	No.	Description
Screen 1  Screen 2  Screen 3 	1	Error at the equipment. Details are indicated on the display of the equipment.
	2	Gear stage rotation inner drill string
	3	Gear stage rotation outer drill string
	4	Filling level diesel
	5	Temperature hydraulic oil
	6	Active operation mode (OFF / ROM / SPM)
	7	State of the safety device
	8	Gear stage feed gear
	9	Engine speed
	10	Temperature cooling fluid diesel engine
	11	Pressure rotation inner drill string
	12	Pressure drifter percussion
	13	Pressure feed function
	14	Pressure rotation outer drill string
	15	Pressure of the cylinder functions
	16	Pressure load compensation
	17	Mast inclination (option)

14.9.1.6 Function assignment of the radio remote control in driving mode

To operate the drill rig in tramming mode, the mode-switch (see page 185) must be switched in position 1. After actuation of the reset key, the tramming functions are released.

The following table shows the function assignment of the controls in driving mode.

Pos.	Pictogram	Operation of the controls	Function
D1		no	Status-LED
D2		no	Status-LED battery no. 1
D3		no	Status-LED battery no. 2
S1			Driving right track
	Option		Option
S2	Option		Option
	Option		Option
S3			Driving left track
	Option		Option
S4			Horn
S5			Start radio transmission / diesel engine
S6			Feed speed stage 1 + 2: no actuation: slow feed speed press the key once: fast feed speed press the key again: slow feed speed
S7			Option Temporary retraction force increase (see description on page 198)
S8			Drill head switching 3 gear stages: shift up into a faster gear stage
S9			Drill head switching 3 gear stages: shift down into a slower gear stage
S10			Drill head switching 2 gear stages: no actuation: slow rotation press the key once: fast rotation press the key again: slow rotation
S11			Reset

Pos.	Pictogram	Operation of the controls	Function
S12			Mode-switch: 1 = tramming mode 2 = alignment mode 3 = drilling mode 4 = no function 5 = no function
S13			Flushing 1 open/close
S14			Flushing 2 open/close
S15			Forward = Water pump A switched on 0-position = Water pump A + B switched off Backward = Water pump B switched on
S16			Forward = Rope winch function on S3 activated Backward = Outer drill string rotation on S3 activated
S17	Option		Option
S18			Selector switch operation mode 1 = OFF 2 = ROM 3 = SPM
S19			Forward = Glide sledge shifting in drilling axis Backward = Glide sledge shifting out of drilling axis
S20			Forward = close clamping device 1 Backward = open clamping device 1
S21			Forward = close breaking device Backward = open breaking device
S22			Breaking device breaking function
S23			Forward = slew auger cleaner in drilling axis Backward = slew auger cleaner out of drilling axis or Forward = clamping-/breaking device shifting forward Backward = clamping-/breaking device shifting backward
S24			Forward = Tandem sledge shifting forward Backward = Tandem sledge shifting backward
R1	Option		Option. Pre-selection rotation drill string (rotation speed regulation)
R2			Regulation of the diesel engine speed

Pos.	Pictogram	Operation of the controls	Function
R3			Regulation feed pressure
R4			Flow regulation of the water pump A or water pump B

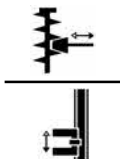
14.9.1.7 Function assignment of the radio remote control in alignment mode

To operate the drill rig in alignment mode, the mode-switch (see page 185) must be switched in position 2. The keys on the three joysticks (symbol ) are without function in this mode.

The following table shows the function assignment of the controls in alignment mode.

Pos.	Pictogram	Operation of the controls	Function
D1		no	Status-LED
D2		no	Status-LED battery no. 1
D3		no	Status-LED battery no. 2
S1			Propping cylinder (rear right) Forward = extend piston rod Backward = retract piston rod
			Drill mast shifting
S2			Forward = Drill mast tilting forward Backward = Drill mast tilting backward
			To the left = Drill mast slewing to the left To the right = Drill mast slewing to the right
S3			Propping cylinder (rear left) Forward = extend piston rod Backward = retract piston rod
	Option		Option
S4			Horn
S5			Start radio transmission / diesel engine
S6			Feed speed stage 1 + 2: no actuation: slow feed speed press the key once: fast feed speed press the key again: slow feed speed
S7			Option Temporary retraction force increase (see description on page 198)

Pos.	Pictogram	Operation of the controls	Function
S8			Drill head switching 3 gear stages: shift up into a faster gear stage
S9			Drill head switching 3 gear stages: shift down into a slower gear stage
S10			Drill head switching 2 gear stages: no actuation: slow rotation press the key once: fast rotation press the key again: slow rotation
S11			Reset
S12			Mode-switch: 1 = tramming mode 2 = alignment mode 3 = drilling mode 4 = no function 5 = no function
S13			Flushing 1 open/close
S14			Flushing 2 open/close
S15			Forward = Water pump A switched on 0-position = Water pump A + B switched off Backward = Water pump B switched on
S16			Forward = Rope winch function on S3 activated Backward = Outer drill string rotation on S3 activated
S17	Option		Option
S18			Selector switch operation mode 1 = OFF 2 = ROM 3 = SPM
S19			Forward = Glide sledge shifting in drilling axis Backward = Glide sledge shifting out of drilling axis
S20			Forward = close clamping device 1 Backward = open clamping device 1
S21			Forward = close breaking device Backward = open breaking device
S22			Breaking device breaking function

Pos.	Pictogram	Operation of the controls	Function
S23			Forward = slew auger cleaner in drilling axis Backward = slew auger cleaner out of drilling axis or Forward = clamping-/breaking device shifting forward Backward = clamping-/breaking device shifting backward
S24			Forward = Tandem sledge shifting forward Backward = Tandem sledge shifting backward
R1	Option		Option. Pre-selection rotation drill string (rotation speed regulation)
R2			Regulation of the diesel engine speed
R3			Regulation feed pressure
R4			Flow regulation of the water pump A or water pump B

14.9.1.8 Function assignment of the radio remote control in drilling mode

To operate the drill rig in drilling mode, the mode-switch (see page 185) must be switched in position 3 and the safety device must be released by actuation of the reset-key (S11).

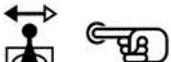
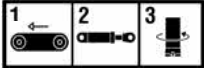
To activate the drilling function “outer drill string rotation” or the rope winch functions, note position of the switch S16!

In the drilling mode, the keys (symbol ) on the joysticks (S1-S3) can be used to save (symbol ) a desired speed of the function feed (Joystick S1), inner drill string rotation (Joystick S2) and outer drill string rotation (Joystick S3). For the function fast feed, there is no speed saveable. To save a speed of the above called functions, the corresponding joystick must be brought into the desired speed position and then the key on the joystick must be actuated. The saving of the preset speed is canceled by pressing the key on the joystick or by actuating the joystick in the opposite functional direction.

Optional the function drifter percussion and the release of the crane functions can be saved.

The following table shows the function assignment of the controls in drilling mode.

Pos.	Pictogram	Operation of the controls	Function
D1		no	Status-LED
D2		no	Status-LED battery no. 1
D3		no	Status-LED battery no. 2

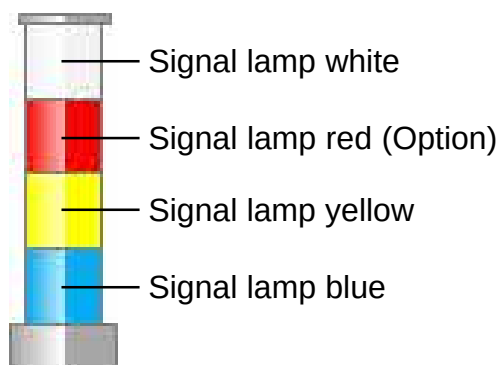
Pos.	Pictogram	Operation of the controls	Function
S1			Forward = feed forward Backward = feed backward
			To the left = fast feed forward To the right = fast feed backward
S1 + S11			Drill mast shifting (only with pressed reset key)
S2			Rotation inner drill string
			To the left = Drifter percussion To the right = Release functions of the optional mountable crane
S3			Switch S16 activated to outer drill string rotation: outer drill string rotation
			Switch S16 activated to rope winch functions: winding up and winding off rope of rope winch (only with pressed key on the joystick)
	Option		Option
S4			Horn
S5			Start radio transmission / diesel engine
S6			Feed speed stage 1 + 2: no actuation: slow feed speed press the key once: fast feed speed press the key again: slow feed speed
S7			Option Temporary retraction force increase (see description on page 198)
S8			Drill head switching 3 gear stages: shift up into a faster gear stage
S9			Drill head switching 3 gear stages: shift down into a slower gear stage
S10			Drill head switching 2 gear stages: no actuation: slow rotation press the key once: fast rotation press the key again: slow rotation
S11			Reset
S12			Mode-switch: 1 = tramming mode 2 = alignment mode 3 = drilling mode 4 = no function 5 = no function

Pos.	Pictogram	Operation of the controls	Function
S13			Flushing 1 open/close
S14			Flushing 2 open/close
S15			Forward = Water pump A switched on 0-position = Water pump A + B switched off Backward = Water pump B switched on
S16			Forward = Rope winch function on S3 activated Backward = Outer drill string rotation on S3 activated
S17	Option		Option
S18			Selector switch operation mode 1 = OFF 2 = ROM 3 = SPM
S19			Forward = Glide sledge shifting in drilling axis Backward = Glide sledge shifting out of drilling axis
S20			Forward = close clamping device 1 Backward = open clamping device 1
S21			Forward = close breaking device Backward = open breaking device
S22			Breaking device breaking function
S23			Forward = slew auger cleaner in drilling axis Backward = slew auger cleaner out of drilling axis or Forward = clamping-/breaking device shifting forward Backward = clamping-/breaking device shifting backward
S24			Forward = Tandem sledge shifting forward Backward = Tandem sledge shifting backward
R1	Option		Option. Pre-selection rotation drill string (rotation speed regulation)
R2			Regulation of the diesel engine speed
R3			Regulation feed pressure
R4			Flow regulation of the water pump A or water pump B

14.10 Signal tower operation modes

To ensure a safe operation of the equipment, it has three operation modes which can be selected by the operator (see chapter 13 on page 115). By using a lockable operation mode selector switch, the operation modes must be activated by the operator. The activated operation mode is indicated by a signal tower.

Signal tower of the equipment



In the following table the lighting states of the signal tower are described:

Leuchtzustände Signalsäule / Lighting states of the signal tower				
Farbe / Color	Funktion / Function	Bedeutung / Meaning		
		Aus / Off 	Blinken / Flashing 	An / On 
Weiß / White	Funkfernsteuerung aktiv, Fahren mit Funkfernsteuerung Remote control active, Driving with remote control	Das Gerät wird nicht fernge- steuert und steht Equipment is not remotely controlled and stands still	Gerät fährt Equipment drives	Gerät wird fernge- steuert Equipment is controlled via the remote control
Rot / Red (Option)	Überlastanzeige Seilwinde Overload indication rope winch	Seilwinde nicht überlastet (0% - 90%) Rope winch not overloaded (0% - 90%)	90% der Nennlast der Seilwinde erreicht 90% of the nominal load of the rope winch is reached	100% der Nennlast der Seilwinde erreicht 100% of the nominal load of the rope winch is reached
Gelb / Yellow	SPM (Special Protective Mode)	SPM nicht aktiv SPM not active	-	SPM aktiv SPM active
Blau / Blue	ROM (Restricted Operation Mode), Zustand des Käfigs ROM (Restricted Operation Mode), State of the safety guard	ROM nicht aktiv ROM not active	Käfig geöffnet Safety guard opened	ROM aktiv, Käfig geschlossen ROM active, Safety guard closed
Wenn die Maschine automatisch von SPM nach ROM umschaltet leuchten sowohl die blaue als auch die gelbe Lampe. If the equipment switches automatically from SPM to ROM, the blue lamp and the yellow lamp lights up.				

14.11 Load compensation / manually applied load control

Terms:

1. Feed pressure

The hydraulic pressure that is present in the working line of the function “feed forward” is called “feed pressure”. The feed pressure is measured in bar.

2. Applied load

The load with which the drill bit is pressed to the ground or to the bottom of a drill hole is called “applied load”. The applied load is measured in N, kN or converted into kilograms or tons.

The applied load consists of the following loads:

1. The weight force of the complete drill string, which acts on the drill bit.
2. The feed force which is generated by the feed system.

3. Load compensation

The load compensation occurs automatically by a load-holding valve. The load-holding valve restricts the return oil at the feed motor, until a certain pressure (30 bar) is created on the feed motor inlet side. The result is a minimum force to the feed chain, which cannot be reduced readily.

Description

The drill rig is equipped with an automatic load compensation which ensures, that a force counteracts the feed force to avoid an uncontrolled sinking of the drill head unit. The automatic load compensation works in the modes OFF, ROM and SPM.

Depending on the drilling system it may be possible that the automatic counterforce is not sufficient to counteract effectively against the existing applied load.

An indication for this overload can be:

the drill mast is pushed away from the drilling point.

The percussion function of a down the hole hammer does not stroke because of a too high applied load.

The use of drilling tools, that are sensitive against high applied load.

If the automatic load compensation does not work effectively, the automatic load compensation can be switched off by activating the manually adjustable applied load control (option).



The manually applied load control can only be switched on in OFF Mode (OFF) and in Special Protective Mode (SPM), and is only active in forward direction of the feed function.

Regardless of the switch position, the applied load control is deactivated in Restricted Operation Mode (ROM), at standstill, with actuation of the fast feed function and actuation of the feed function in “pulling” direction. Then the equipment works with the automatic load compensation.



Danger of accident!

A to low regulation of the applied load control can lead to accidents with heavy injuries to persons, such as crushing and collision injuries.

In particular, by activation of the feed function with a to low regulation of the applied load control, the glide sledge can free fall to the bottom of the drill mast.

Δ During working with the equipment, all persons must be outside the danger zone. Only after the equipment has stopped completely (the equipment makes no more movements), the entry into the danger zone is allowed.

Δ The applied load control is used to balance the weight of the drill head unit including drilling accessories. Because the weight changes by attaching or removing drilling accessories, adjusting the applied load control is necessary in the drilling process to avoid an uncontrolled lowering of the drill head unit on the drill mast.

Operation elements of the manually applied load control at the equipment

Functions of the manually applied load control				
Control box at the base unit	No.	Pictogram	Operation of the controls	Function
	1			Selector switch manually applied load control (option) 0 = off 1 = on
	2			Adjustment manually applied load control (option)

Example for a correct setting of the applied load control

1. Align the drill mast into drilling inclination.
2. Mount the drilling accessories.
3. Operate the feed function and set lever immediately in neutral position.
4. If the glide sledge is further lowering after setting lever in neutral position, the pressure adjustment of the applied load control must be increased. The right adjustment is reached if the glide sledge stops immediately after setting the lever of the feed function in neutral position.
5. If the glide sledge doesn't move forward when the feed function is operated, the pressure adjustment of the applied load control must be reduced.

14.12 Temporary retraction force increase / retrieval function

Working in case of retrieval the drill string

The extra ordinary case of retrieval of the drill string arises, if the drilled drill string can not be pulled out of the drill hole by the retraction force of the fast retraction feed function.

The temporary retraction force increase is used to increase the retraction force briefly in case of retrieval the drill string only. The retrieval case is an exceptional case within the regular drilling operation.

NOTICE

Risk of causing damage to components!

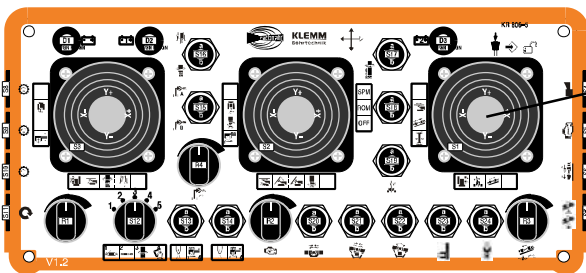
Components of the equipment can be damaged by an improper using of the temporary retraction force increase.

- Δ The temporary retraction force increase must only be used for the retrieval case!
- Δ After each operation of the temporary retraction force increase, the wear of the feed system, in particular of the feed chain, must be checked. Renew worn parts immediately.

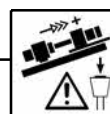
14.12.1 Operating elements of the temporary retraction force increase at the equipment



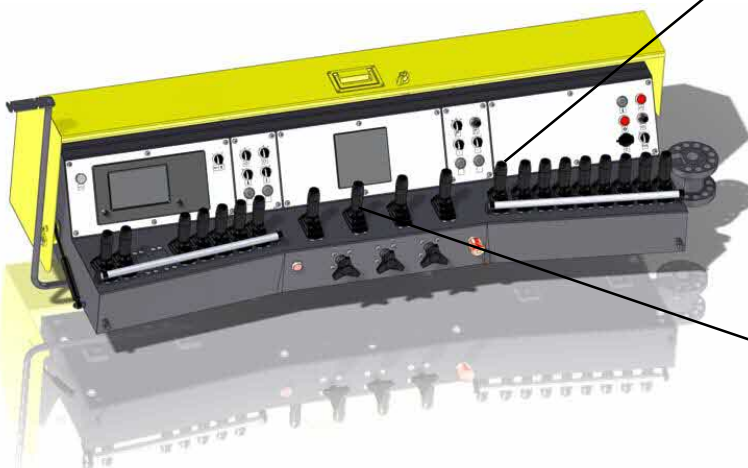
The temporary retraction force increase can only be activated via the corresponding key on the radio remote control or the electric control panel, when the function fast feed backwards is operated and the lower clamping device (clamping device 1) is open.



Joystick right:
Fast feed backwards

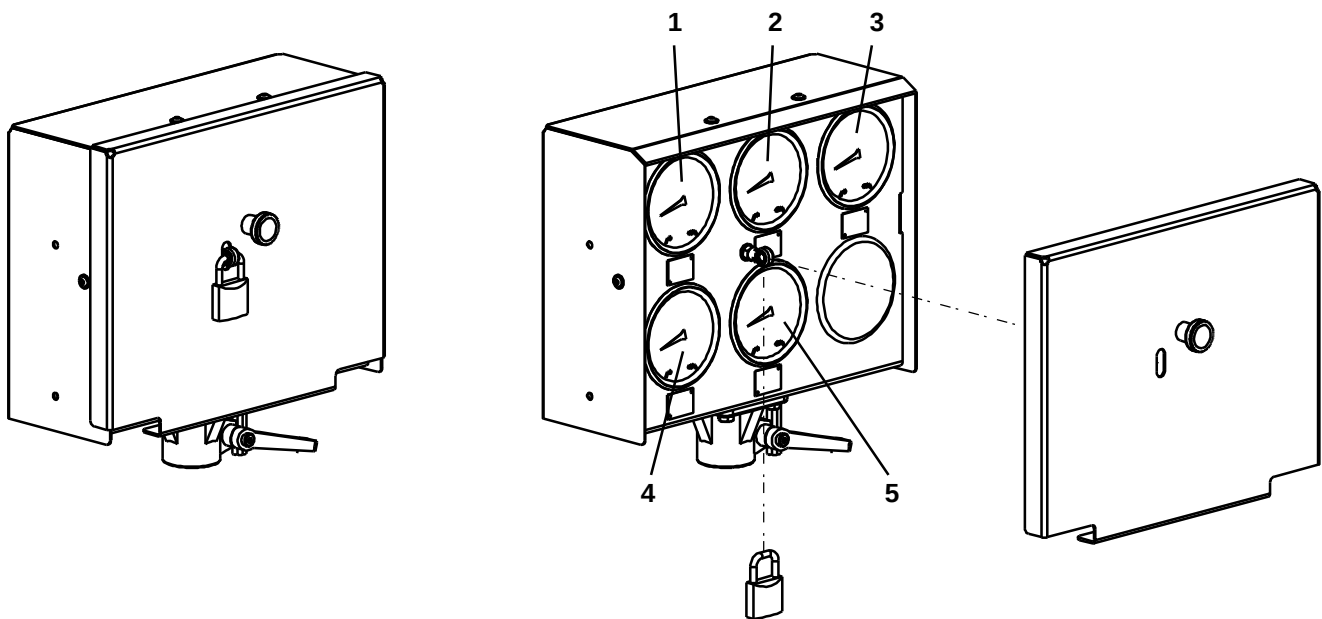


Key to activate the temporary
retraction force increase



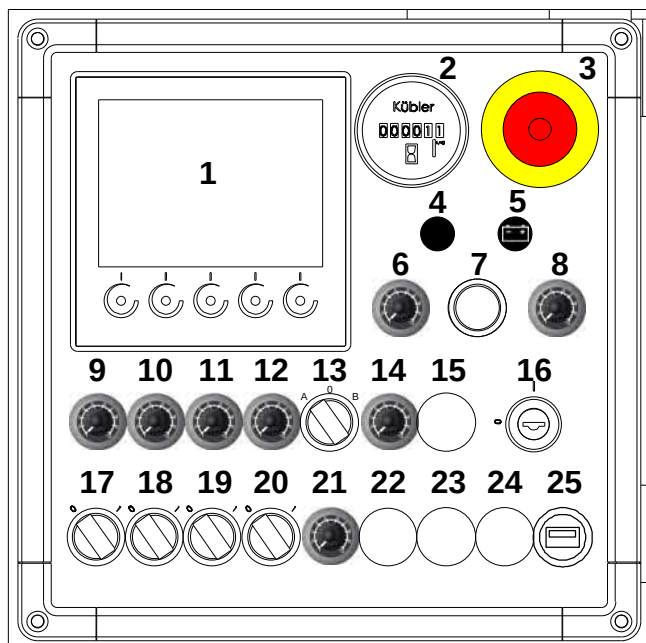
Joystick backward:
Fast feed backwards

14.13 Pressure gauges for the alignment functions and the main drilling functions

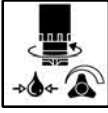
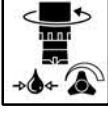
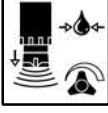
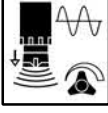
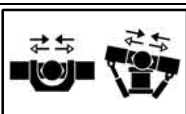


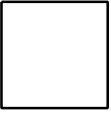
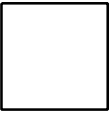
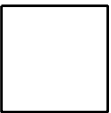
Pressure gauge marking		
No.	Pictogram	Function
1		Hydr. drifter percussion
2		Rotation inner drill string
3		Rotation outer drill string
4		Feed pressure
5		Clamping functions / alignment functions

14.14 Control box at the base unit



Functions at the control box			
No.	Pictogram	Operation of the controls	Function
1			Display engine monitoring See description on page 133
2			Operating hours counter
3			Emergency stop
4			Fault indicator lamp diesel engine Lights up permanent if a engine error occurs. The error is displayed as a text message in the display of the engine monitoring.
5			Battery charging control lamp
6			Option Power Sharing (manually) see description on page 161

Functions at the control box			
No.	Pictogram	Operation of the controls	Function
7			Horn
8			Regulation of the diesel engine speed
9			Pressure regulation inner drill string rotation
10			Pressure regulation outer drill string rotation
11			Pressure regulation hydraulic drifter percussion
12			Frequency regulation hydraulic drifter percussion
13			Selector switch water pump A = water pump A switched on 0 = water pump A + B switched off B = water pump B switched on
14			Water pump flow regulation
15			Option
16			Ignition lock
17			Selector switch working lights 0 = off 1 = on
18			Selector switch cleaning device 0 = off 1 = on
19			Selector switch pressure sensor clamping left = pressure sensor clamping in clamping device active right = pressure sensor clamping in breaking device active

Functions at the control box			
No.	Pictogram	Operation of the controls	Function
20			Selector switch manually applied load control (Option) 0 = off 1 = on
21			Regulation manually applied load control (Option)
22			Option
23			Option
24			Option
25			USB-Slot for electronic storage medium

15 Transport



Danger of accident!

Improper use can cause an accident. This could result in serious or fatal injuries to persons.

Δ Please read and observe the following chapter on safety before performing tasks or processes according to this chapter:

Danger area and safety distance

Safety when handling ropes

Safety when handling suspended loads and during transport

NOTICE

Risk of causing damage to the equipment or the components!

During transport, incorrect tying down and lifting by incorrect attaching of the slings and the lifting devices can lead to damage of the equipment and/or components.

Δ Cover and secure any sharp edges, points, and cutting edges.

Δ Use a lifting device which is adequately dimensioned.

Δ Only attach the slinging gear to the tying points provided for that purpose and only attach the lifting gear to the lifting points provided for that purpose.

Δ Only use suitable lifting gear/slinging gear with adequate load-bearing capacity.

15.1 Transport guidelines

The transport company must be given all necessary dimensions and weights as well as the route.

The driver from the transport company must inspect and guarantee that the equipment and its accessories are properly secured before beginning every drive.

Information on the lashing forces necessary should be available to ensure proper lashing.

Only store accessories where they do not pose an obstacle e.g. to public or construction site traffic. Also secure accessories so that any unintentional or unauthorized factors do not create a hazard.

Position the transport vehicle on horizontal and level ground with a sufficiently stable surface.

For equipment that must be driven onto/off of the transport vehicle, be sure to level the loading surface of the transport vehicle to achieve the flattest ramp angle possible.

Move the loading surface of the transport vehicle into a horizontal position and remove any ice, snow or sludge. Lay out suitable no-slip mats.

Make sure the dimensions of the loading surface on the transport vehicle are sufficient. If necessary, take appropriate measures such as constructing suitable extensions.

Use suitable ramps for equipment that must be driven onto/off of the transport vehicle. Be sure to observe the maximum acceptable load and ramp incline angle. The ramps must also be adjustable according to the track width.

Extend outriggers on the transport vehicle (if available) for loading/unloading.

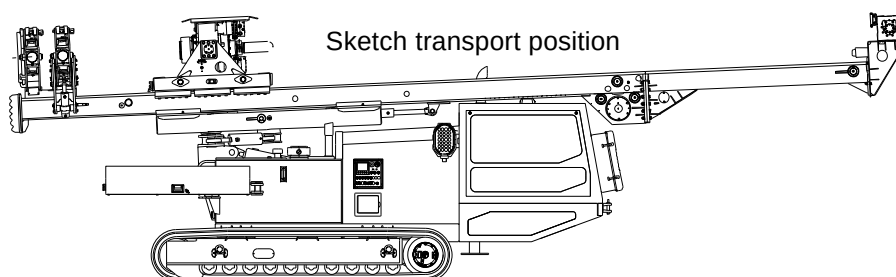
15.2 Transport mode

15.2.1 Before loading

Before loading, bring the base machine into transport position, drive onto the transporting vehicle, or lift onto the transporting vehicle with a suitable lifting device.

The base machine is in the transport position, if

- the upper carriage is positioned parallel to the undercarriage in the main direction of travel and locked to it (only for equipment with rotatable uppercarriage).
- all of the drilling equipment have been removed from the mast.
- the mast has been fully lowered in transport position.
- Mast extension elements has been removed from the base drill mast (if present).
- the telescoping cylinders of the crawlers are fully retracted (only for equipment with telescopic undercarriage, excluded small drill rigs).
- the cat head with rope winch is positioned in transport position (for collapsible or rotatable cat heads).
- projecting brackets, holding brackets, and steps are folded into transport position or properly removed.
- movable parts are locked and secured.
- sharp edges, points, and cutting edges are covered and secured.



The transport dimensions are given in the technical data.

15.2.2 After loading

Switch off the diesel engine by turning the ignition key to position "0".

Remove the ignition key.

Set the battery main switch to position "0".

Close all doors and remove the keys.

Secure the equipment by tying it down on the loading bed.

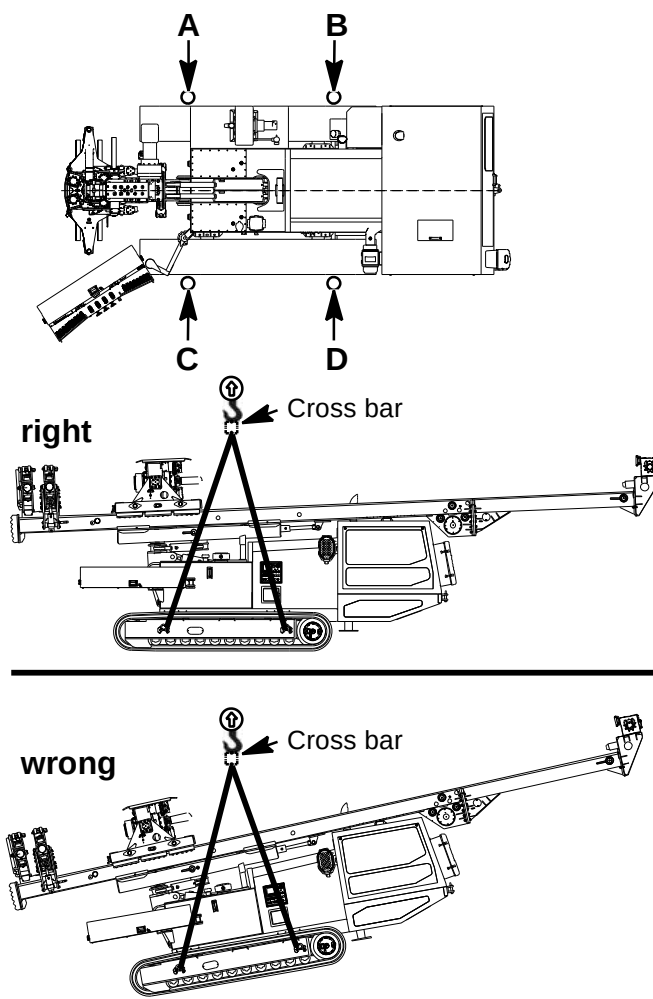
15.2.3 Lifting the equipment

NOTICE

Risk of causing damage to the equipment or the components!

Attach the ropes in such a way, that they cannot get in contact with machine parts (e.g. hose guide chain) when lifting the drill rig. When lifting the equipment, the equipment must take off and remain in horizontal position.

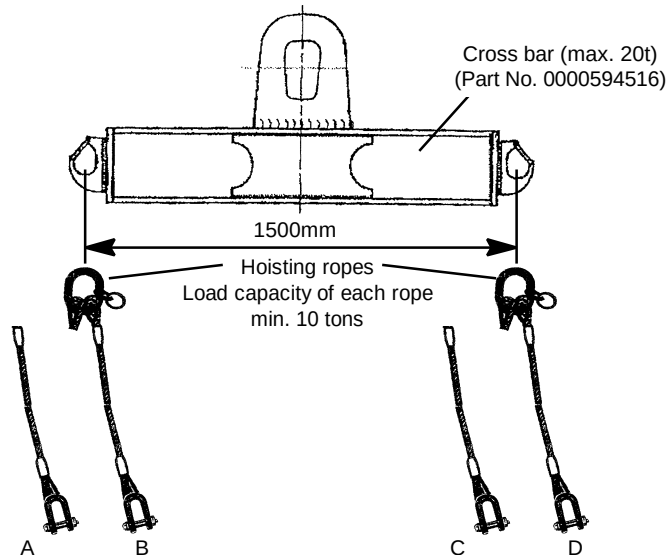
Δ KLEMM Bohrtechnik recommends the use of the crane cross bar. To reach the indicated overall center of gravity the equipment must be brought into the shown loading position before lifting.



Marking (green) of the lifting points A-D at the equipment

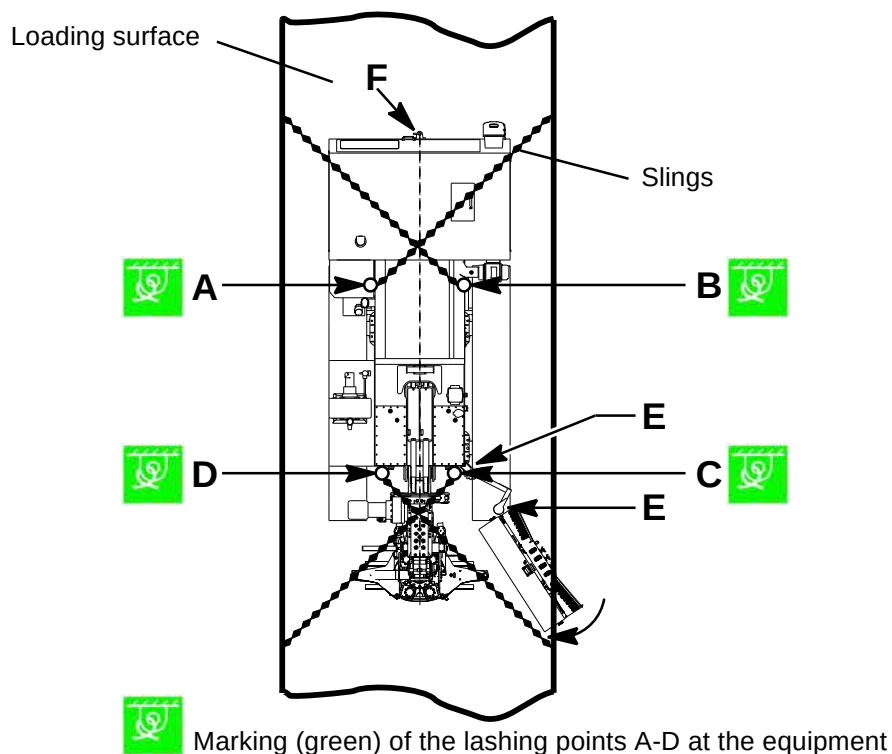
15.2.3.1 Cross bar with hoisting ropes for crane loading of the equipment

For loading KLEMM Bohrtechnik drill rigs with drill mast in transport position by using a crane, you have to use a cross bar with hoisting ropes (see sketch).



15.2.4 Lashing the equipment

- A-D : Attachment points for lashing the equipment for truck transport
- E : Swing in the control panel or the reception for the radio remote control completely and secure it with the bolting devices against unintentional swinging out!
- F : The equipment must not be lashed at the drag hitch!



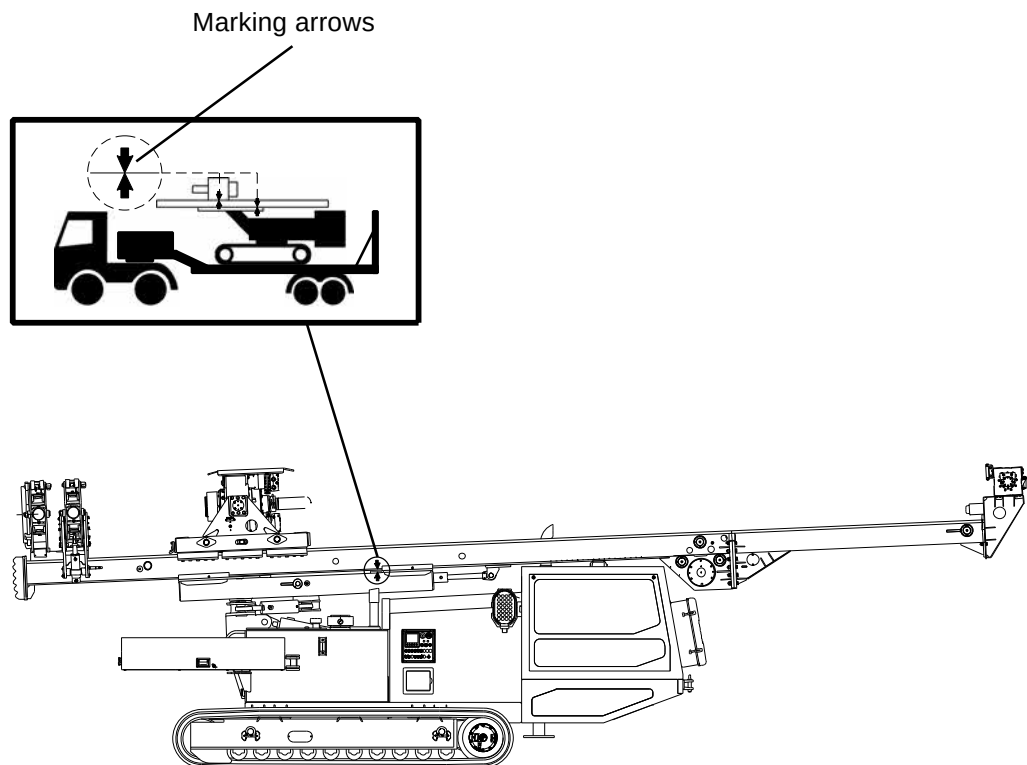
15.2.5 Align the drill mast in transport position

NOTICE

Risk of causing damage to the equipment or the components!

When align the drill mast in transport position, machine components can collide and be damaged.

- Δ Before the alignment of the drill mast into transport position, the drill mast must be positioned on the mast carrier, that the attached marking arrow are pointing at each other (see sketch).
- Δ The drill mast must not be shifted forward or backward when the drill mast is aligned in transport position, resting on mast support. Shifting the drill mast must only be done, when drill mast is erected that far out of transport position, that a collision of machine components is not possible when shifting the drill mast.



16 Maintenance/repair



Danger of accident!

Improper use can cause an accident. This could result in serious or fatal injuries to persons.

Δ Please read and observe the following chapter on safety before performing tasks or processes according to this chapter:

Safety during maintenance and environmental protection/waste disposal

Safety when handling ropes

16.1 General

Maintenance/repair guidelines:

- All maintenance work must be performed in accordance with the maintenance table and associated chapters found in this instruction manual. The appropriate subcontracted component manufacturer's documentation must also be observed.
- The individual inspection points in the maintenance table reflect the "target condition" of each component. Have any defects remedied immediately.
- The maintenance work outlined by the manufacturer must be regularly and completely performed and documented.
- Any maintenance work performed must be consistently registered and marked in the service logs by an appropriate person in charge.

16.1.1 Expert inspection

The entire equipment must be inspected by an expert at regular intervals (in Germany, for example, this is once per year). The inspection intervals must be performed in accordance with countryspecific or regional laws, regulations, guidelines and standards.

The expert inspection may only be performed by a specially qualified person.

16.1.2 Maintenance intervals

Maintenance intervals are determined according to hours of operation/calendar periods. The first interval reached always applies.

The following maintenance intervals have been set:

- After 10 hours of operation or daily
 - After 50 hours of operation or weekly
 - After 500 hours of operation or quarterly
 - After 1000 hours of operation or annually
- Special intervals

Maintenance intervals are expanded for normal operation. This means that when maintenance work is due for e.g. 1000 hours of operation, maintenance must also be performed every 10, 50, 250 and 500 hours of operation.

Under extreme environmental conditions, it may be necessary to perform maintenance at shorter intervals. Such extreme environmental conditions include heavy dust build-up and extreme moisture.

16.1.3 Hoses

Have hoses regularly inspected by a specially qualified person. Be sure to observe national standards and guidelines in the country of use.

16.1.4 Connection elements

Screw connections and plug connections should always be manufactured according to the applicable standards of good practice.

Bolt torque values for screws can be found in generally accepted tables if no specific indication is made regarding the bolt torque values in the instruction manual or spare parts list.

16.1.5 Welding

Welding works at the equipment are not allowed! Necessary weldings are only to be done by qualified personnel of KLEMM Bohrtechnik.

16.1.6 Pressure tank

Pressure tanks must be inspected, maintained, repaired, used and transported in accordance with country-specific or regional laws, regulations, guidelines and standards (in Germany, for example, according to DIN EN 13445 part 2, among others).

Only have the pressure tanks inspected by specially trained persons and serviced by appropriately authorized skilled personnel.

16.1.7 Cylinders

NOTICE**Risk of damage to piston rods!**

Corrosive environments can cause corrosive damage to extended piston rods.

Δ Move extended piston rods in and out multiple times according to environmental factors or treat with hydraulic oil.

Δ Preserve extended piston rods with acid-free grease for longer downtimes.

Check that the cylinders are in proper working order.

Check connection elements for completeness, firm seating and integrity.

Replace any defective connection elements.

Check locking elements for completeness, firm seating and integrity.

Replace any defective locking elements.

Cleaning piston rods

NOTICE**Risk of damage to piston rods!**

Steam jet devices, tools with sharp edges, caustic fluids or cleaning agents can damage the piston rods.

Δ Do not clean the piston rods with the above mentioned devices and cleaners.

Check the cylinders before cleaning for any ejected media (e.g. hydraulic oil).

Clean the cylinders.

Clean the piston rods.

Move the piston rods in and out multiple times, then treat with hydraulic oil.

Leakage testing

Prerequisite: The cylinders and piston rods have been cleaned.

Check piston rods for integrity.

Visually check the cylinders for leaks.

Replace defective cylinders as described in Chapter "Replacing cylinders".

The cylinders have been checked for leaks.

Replacing cylinders

Prerequisite:

- The equipment has been shut off.
- Components connected to the cylinder have been released and secured accordingly.
- The cylinders and their supply system have been de-pressurized.
- A suitable container for old oil is at the ready.

Disconnect the appropriate cylinder from the supply system.

Close the supply ports to the cylinder.

Remove the cylinder.

Install the new cylinder.

Connect the new cylinder to the supply system.

If necessary, vent the supply system.

Lubricating cylinder joints

Clean cylinder joints and lubrication points.

Lubricate each cylinder joint on the appropriate lubrication points.

16.1.8 Bearings and bearing pins

Check the bearings and bearing pins according to the applicable standards of good practice.

Bearing and bearing pin tolerances can be found in generally accepted tables if no specific indication is made regarding tolerances in the instruction manual or spare parts list.



The relevant inspection intervals are defined in the maintenance tables of this instruction manual.

Lubricating bearing connections and plug connections

Clean bearing connections and plug connections.

Clean lubrication points.

Grease each bearing connection and plug connection on the appropriate lubrication points.



The relevant lubrication intervals are defined in the maintenance tables of this instruction manual.

16.1.9 Additional components on the equipment

On Klemm equipment, additional components (e.g. rope winches, welding generators, water pumps, etc.) are mounted. These components are purchased from Klemm Bohrtechnik, and installed according to the installation instructions of the manufacturer. These components usually have an own type plate and an own documentation.



Danger of accident!

Non-observance of the following references can lead to serious or fatal accidents for persons.

NOTICE

Risk of causing damage to components!

Components of the equipment could be damaged by an improper use of additional components.

The following instructions must be adhered without exception.

- Δ The documentation of additional components includes information on the operation and maintenance of the components that must be adhered by the operator. This documentation of the component manufacturer is attached to the documentation of the equipment. From the documentation of the Klemm equipment is referred to these components documentation.

16.2 Scope of the 100 hour inspection

100 hour inspection

The first inspection must be made after 100 operating hours.

The following points must be dealt with:

- Change engine oil and filter

- Change hydraulic filter

- Check gear oil levels

- Check screw connections for tight fit, tighten if necessary

- Checking welded structures

- Checking system pressures

- Eliminating possible leakages

as well as performing all the work that is listed in the 10 hour table
(see lubrication, maintenance and inspection schedule).

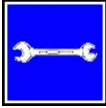
The 100 hour inspection must be made by KLEMM Bohrtechnik Customer Service or an authorised dealer.

The maintenance work must be recorded and countersigned in the service log by the machine operator responsible upon completion. The KLEMM Bohrtechnik company will be allowed access to this log in the event of claims under the warranty. Failure to do this work will lead to voiding of the warranty.

16.3 Maintenance table

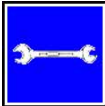
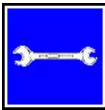


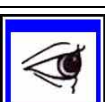
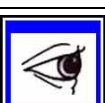
For a better overview, each maintenance task has been assigned a symbol in the individual maintenance tables:

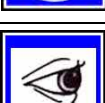
Symbol	Description
	All work involving oils (except for oil changes)
	Oil changing
	Visual checks of all types
	Cleaning
	Lubricating
	All "active" maintenance tasks such as replacing, adjusting, configuring and repairing.

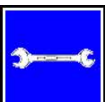
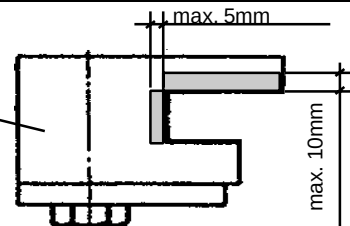


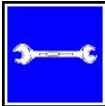
Maintenance tasks on supplier components are not always completely listed in this instruction manual. Please refer to the appropriate information in the relevant maintenance tables.

Maintenance table					
Symbol	Maintenance interval				Task
	10	50	500	1000	
					Operation and control elements
					Check for proper operation.
					Diesel engine
					For maintenance detailed data of the engine manufacturer must be absolutely observed (see engine manual)! All 500 operation hours an engine inspection is to be accomplished by authorized technical personnel.
					Check oil level
					Change oil (by qualified personnel)
					Clean cooling fins
					Check level of coolant
					Exchange engine oil filter cartridges
					Exchange fuel filter cartridges
					Check air filter contamination and clean if necessary
					Check V-belt tension
					Hydraulic system
					Check oil level

Maintenance table					
Symbol	Maintenance interval				Task
	10	50	500	1000	
					Check for leaks
					Check oil temperature
					Take oil sample of the hydraulic oil and renew the oil if necessary
					Change filters
					Check fittings for tightness
					Check hydraulic hoses on damages and renew them if necessary
					Check cooling fins of the hydraulic oil cooler for pollution and clean if necessary
					Leak and noise control of pumps, gears and motors
					Check hydraulic cylinders for leaks
					Electrical system
					Check the acid level and charging status
					Check the emergency stop function
					Check the function of the safety device

Maintenance table					
Symbol	Maintenance interval				Task
	10	50	500	1000	
					Check the function of the horn
					Check the function of the illumination (option)
					Crawler tracks / Crawler undercarriage
					Check track chain tension
					Check track chain links on damages
					Check oil level of driving gear box (see page 245)
					Change gear oil (see page 245)
					Check steel structure for breaks
					Drill mast
					Check steel structure for breaks
					Grease feed system (chain and chain wheels)
					Feed gear - Check oil level
					Feed gear - change oil
					Check bearings and bushings

Maintenance table					
Symbol	Maintenance interval				Task
	10	50	500	1000	
					Check feed chain on damages and wear
					Check clamping chucks on wear
 					Maintenance of the hydraulic cylinders (see page 210)
					Check wear of the spot drilling guide (approximate max. clearance with respect to rod centralizer: rod diameter + 10mm)
					Check hose guide chain (option) for damages
					Glide sledge
					Check steel structure for breaks
					Check deflectors on wear and renew them if necessary
					Check the bolt connection of the feed chain clamp and tighten the screws with the corresponding tightening torque if necessary. Use Loctite Threadlocker when installing the screws.
					Check wear of guiding strips (max. lateral clearance = 5mm, max. clearance in reference to the drilling center height = 10mm)*
Wear limits of the guiding strips mounted on glide sledges Guiding strip 					

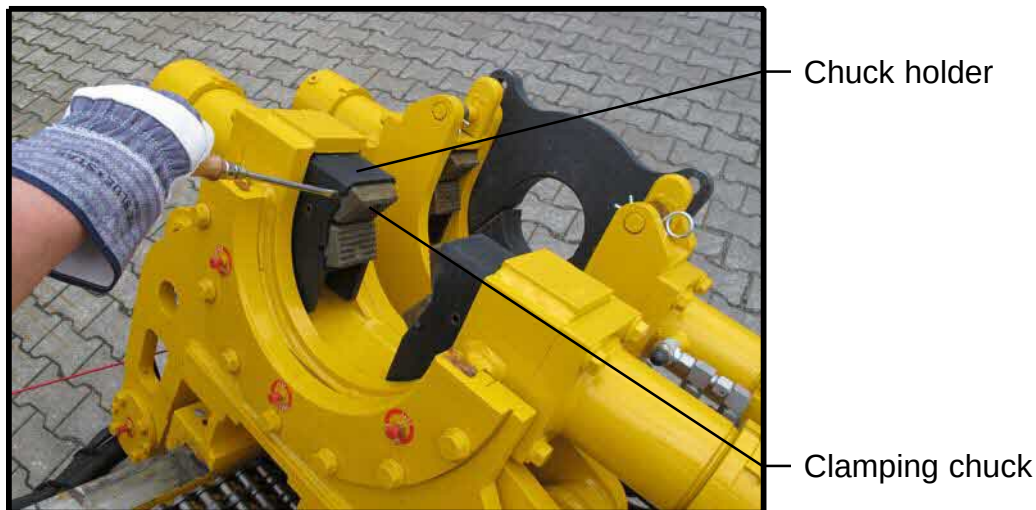
Maintenance table					
Symbol	Maintenance interval				Task
	10	50	500	1000	
					Drill head unit (KH / KD)
					Please refer to the technical manual of the corresponding rotary drill head or hydr. drifter
					Check wear parts of the drilling accessories (e.g. bushings, sealings) and renew them if necessary
					Kinematics
					Check steel structure for breaks
					Gearse all lubrication points
					Check guide rails on wear and grease them
					Check bearings on wear
 					Maintenance of the hydraulic cylinders (see page 210)
					Flushing armature
					Check armatures for function and tightness

16.3.1 Changing clamping chucks on the clamping devices

The toothed clamping chucks used in the clamping and breaking device are to hold the drill rods tight when changing the rods. The teeth exposed to great force during the breaking process are therefore subject to heavy wear.

These clamping chucks should be changed as follows:

1. Move the clamping device about half way closed.
2. Lever the clamping chucks out of the chuck holder with a screwdriver.
3. Do not grease the new clamping chucks in the area of the O-ring.
The clamping chucks and the borehole of the chuck holder must be absolutely free of grease.
4. Insert new clamping chucks in the chuck holder.



16.4 Lubricants

NOTICE

Risk of causing damage to components!

Non-compliance with the following guidelines can cause damage to the components of the equipment.

- Δ Only use prescribed lubricants.
- Δ Do not mix lubricants from different manufacturers.
- Δ Do not mix synthetic and mineral lubricants.
- Δ Do not mix zinc-free and zinc-containing lubricants.
- Δ Only use fresh lubricants.



Incorrect use of lubricants can lead to loss of warranty if damage occurs.

16.4.1 Lubricants table

NOTICE

Risk of causing damage to components!

Components of the equipment can be damaged by the use of unsuitable lubricants.

- Δ Only use the prescribed lubricants with the indicated specifications.

The following table shows the initial filling of the corresponding lubricants.

Lubricants table initial filling		
Fields of use	Lubricant	Quantity (liters)
Diesel engine TAD572VE	Specification: Oil quality VDS-4 (15W-40) VDS = Volvo Drain Specification Original KLEMM oil filling: Aral MegaTurboral VR 10W-40 (according to Volvo VDS-4 - approved engine oils)	approx 16
Hydr. circuit	Mineral hydraulic oil: Specification: Requirements of hydraulic oils HLP (DIN 51524-2) must be fulfilled. VG 32: Ambient temperature -20°C up to +20°C VG 46: Ambient temperature -5°C up to +30°C VG 68: Ambient temperature +5°C up to +40°C Bio hydraulic oil: Specification: VDMA 24'568 HEES (water-insoluble, synthetic esters), ISO 15380 VG 46: field of use for Ambient temperature from -15°C up to +40°C Original KLEMM oil filling: Hydraulic oil Tellus T 46 (VG 46) HVL 46 according to DIN 51524-3 (VG = Viscosity class)	approx 900
Feed gear	Specification: The oil must correspond to the requirements "lubricating oils CPL" according to DIN 51517 part of 3.	approx. 6,5
Driving gear	Original KLEMM oil filling: BP ENERGOL GR-XP 150	approx. 3,0
Grease for general greasing	Specification: DIN 51502, KP2N-30 Original KLEMM oil filling: Lagermeister TS KP2N-30	Grease cartridge 0,4 kg (part-no. 0000692007)



The specified quantities are guideline values. Decisive are the specifications on the respective type signs and the level indicators of the individual components. Alternative lubricants must must comply with the indicated specifications.

16.4.2 Characteristics of different hydraulic oils for KLEMM Bohrtechnik equipment

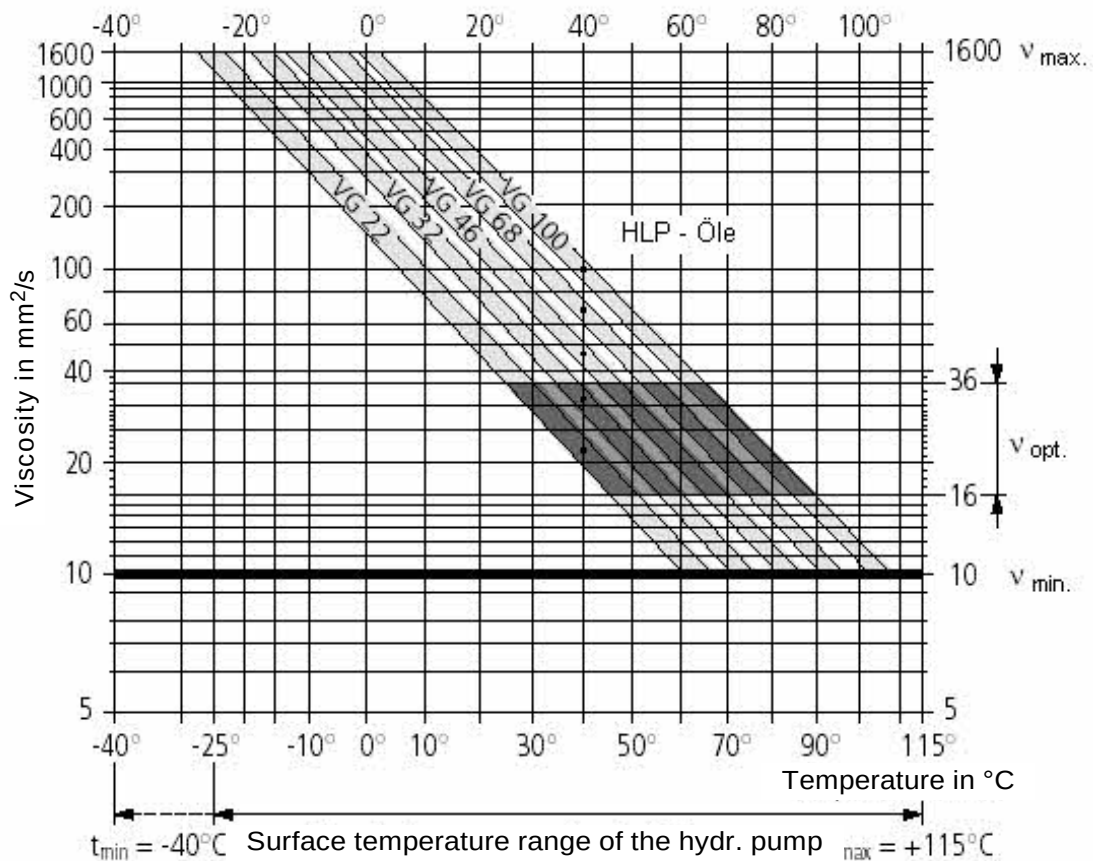
The selection of the right hydraulic-oil and the ambient-outside-temperature-ranges have important influence on hydraulic functions and speeds of the drill rig.

The max. permissible viscosity-range for the hydraulic components is 1600mm²/s only for engine start-up (cold start). For short running times (warm-up phase of diesel engine) the permissible viscosity-range is 1000mm²/s,

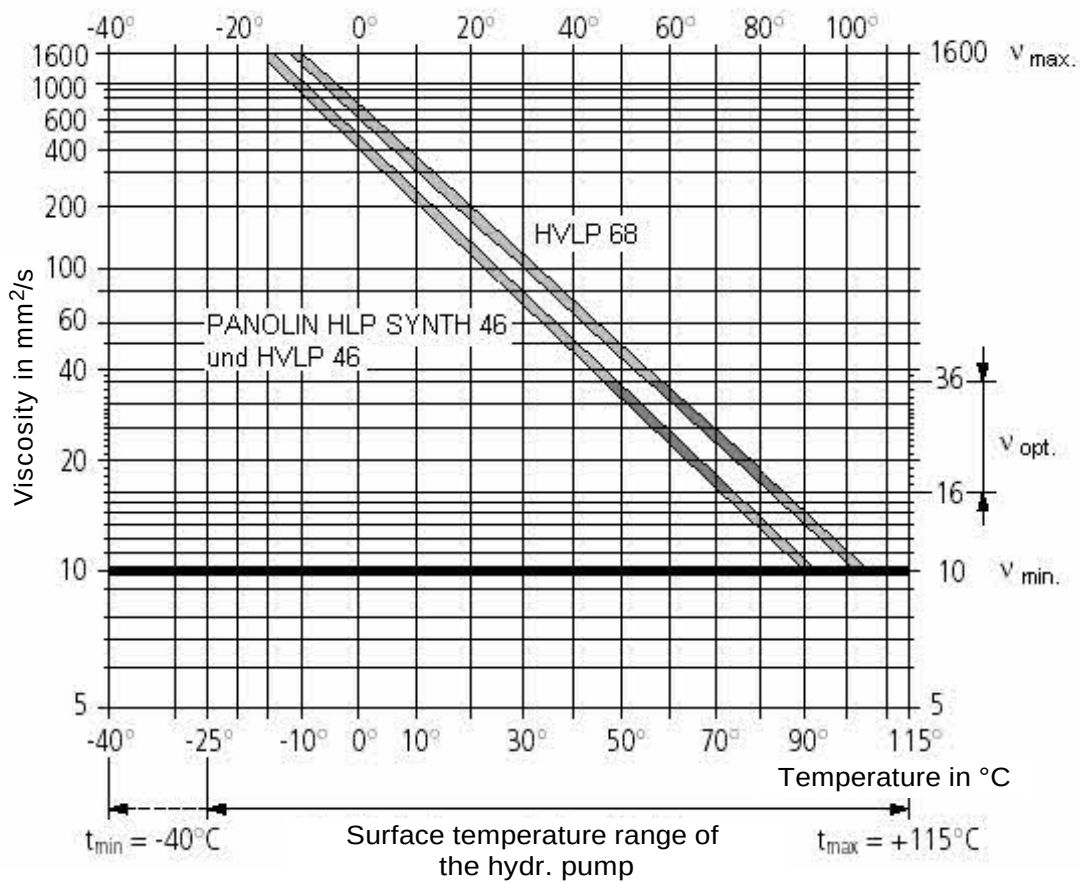
The permitted operating-viscosity-range for the hydraulic components should be between 10mm²/s and 380mm²/s..

The optimum operating-viscosity-range for the hydraulic components should be between 16mm²/s and 36mm²/s. Please refer to the following "Viscosity-Temperature"- diagrams for mineral hydraulic oils and the bio hydraulic oil Panolin HLP Synth 46.

Viscosity-temperature-diagram for mineral hydr. oils



Viscosity-temperature-diagram for bio hydr. oil
Panolin HPL Synth 46 and mineral hydr. oil HVLP 46 + HVLP 68



When hydr. oils of different manufacturers respectively different types of oil from the same manufacturer are mixed, it can lead to silting and sedimentations. These facts can create malfunctions and damages of the hydr. system.



Mineral oils and synthetic oils must not be mixed. Please refer always to the lubricants table initial filling (see table in chapter 16.4.1).



In dependence of the used hydraulic oil, different thermostat settings for the bypass of the oil cooler can be necessary. For questions to this, please contact the customer service of KLEMM Bohrtechnik.

16.5 Hydraulic system

16.5.1 Hydraulic tank



Only replenish the hydraulic oil through the filling opening or through the return line filter after dismantling the filter cover (see following picture).



Filling opening

Cover return-line filter

Checking the oil level



If the oil level falls below the prescribed minimum, the equipment shuts down automatically.

Position the basic unit horizontally.

Retract all hydraulic cylinders as far as possible.

Shut down the equipment.

Read the oil level from the engine control box.



Or alternatively read the oil level from the level indicator on the hydraulic tank.

The maximum oil level is reached when $\frac{3}{4}$ of the level indicator is filled.



maximum oil level ($\frac{3}{4}$ of the level indicator is filled)

minimum oil level

Replenishing the oil

NOTICE

Risk of causing damage to the hydraulics!

Foreign matter in the hydraulics has a negative impact on system safety.

- Δ When working on the hydraulics, make sure that foreign matter finds entry into the hydraulic system.
- Δ Only replenish the hydraulics via the filler opening or through the return line filter after dismounting the filter cover.

Position the basic unit horizontally.

Retract all hydraulic cylinders as far as possible.

Shut the equipment down and wait for 10 minutes.

Open the filling opening at the hydraulic oil tank or the return-line filter. For opening of the return-line filter see chapter 16.5.2 on page 227.

Replenish the hydraulic oil via the opening in the tank.

Check the oil level as described in "Checking the oil level".

Clean the plug and the sealing surface.

Check seal for damage and wear.

If the seal is faulty, replace it with a new one.

Close open oil tank.

The oil has been replenished.

Taking an oil sample



Only take oil samples from the opening on the return-line filter. For opening of the return-line filter see chapter 16.5.2 on page 227.

Shut the equipment down and wait for 10 minutes.

Open the return-line filter (see chapter 16.5.2 on page 227).

Take an oil sample from the opening.

Clean the plug and the sealing surface.

Check seal for integrity and wear.

If the seal is faulty, replace it with a new one.

Close open oil tank.

Have a chemical analysis of the oil carried out.

Change the oil if it may no longer be used.

Changing the oil



An oil change must be carried out by authorized personnel. For questions about oil change please contact the service department of KLEMM Bohrtechnik.

16.5.2 Filter and filter inserts in the hydraulic system



Filter changes must be carried out by authorized personnel. For questions about filter changes please contact the service department of KLEMM Bohrtechnik.

Prerequisite: The equipment has been shut off.

Return-line filter (mesh size: 10 micron)

Part no. filter cpl. with housing (1 piece)	0000960290
Part no. filter insert (1 piece)	0000960411
Part no. contamination indicator	0000279542
Part no. seal kit	0000678309

Filter changes: The first filter change has to be done after 100 operating hours.
Later changes all 500 hours.



Filling opening

Cover return-line filter

Contamination indicator

Bypass filter twofold (option)

Part no. Bypass filter twofold cpl. (1 piece) 0000537225

Part no. filter insert (2 pieces) 0000532862

Filter changes: The filter inserts must be changed after all 250-500 operating hours.
The maximum operating time for the filter elements is 6 month.

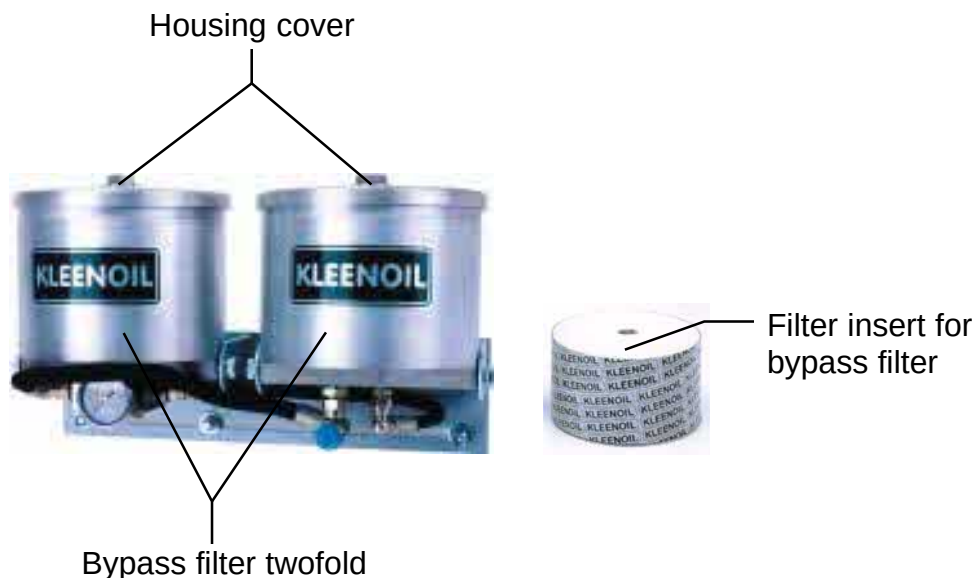
Open housing cover

Remove dirty filter insert

Insert new filter element

Clean the seals and sealing surfaces.

Close housing cover



16.5.3 Cooling system hydraulic oil

NOTICE**Risk of causing damage to cooler!**

The use of sharp-edged tools, acidic fluids, or scouring agents for cleaning can damage the coolers.

Δ Do not clean the coolers with the above mentioned devices or cleaning agents.

Check the coolers for cleanliness, integrity, and wear.



The hydraulik oil cooler is mounted in the rear area of equipment.

16.5.4 Checking of pump pressures at the equipment

To measure the pump pressures of the drill rig, measurement connections are installed in the engine compartment. This measurement connections are located behind the left door of the engine cover (see following sketch). For pressure measurement pressure gauges can be connected to the measurement connections.



Descriptions of the measurement connections			
P 1	Measurement connection P 1 Pump pressure pump 1	LS 1	Measurement connection LS 1 Load pressure pump 1
P 2	Measurement connection P 2 Pump pressure pump 2	LS 2	Measurement connection LS 2 Load pressure pump 2
P 3	Measurement connection P 3 Pump pressure pump 3	P ST	Measurement connection P ST Pressure control oil
P 4	Measurement connection P 4 Pump pressure pump 4	P S2	Measurement connection P S2 Inlet pressure of control oil unit

16.6 Pump distributor gear



For equipment with pump distributor gear, this is arranged in the rear area of the equipment.

Maintenance works: - check oil level
- change oil

Further information can be found in the enclosed additional documentation!

16.7 Diesel engine



The diesel engine is located at the rear area of the equipment. Further information can be found in the enclosed additional documentation.

A detailed instruction manual of the diesel engine belongs to the operating instruction of the equipment. This manual contains a description of the engine, important informations about operating and maintenance of the engine, as well as information on the use of manufacturer-approved operating supplies.

All details of the additional documentation must be observed without exception.

16.7.1 Cooling system of the diesel engine



The diesel engine is located at the rear area of the equipment.

Further information can be found in the enclosed additional documentation!

16.7.2 Lubricating oil system of the diesel engine

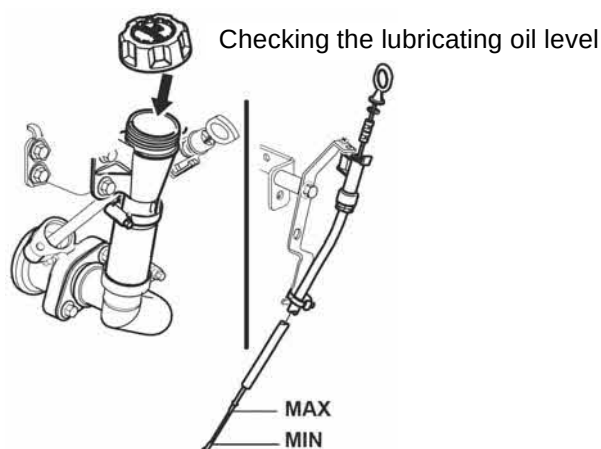
NOTICE

Risk of causing damage to components!

The diesel engine of the equipment can be damaged by a faulty lubricating oil level. Low lubricating oil level and overfilling lead to engine damage. Usually the reason for an increase of the oil level is a transfer of another operating fluid. The reason must be inspected immediately, because this could be an indication of damages of externally mounted components, e.g. hydraulic pumps.

Δ The lubricating oil level must be checked daily.

Δ The lubricating oil level may only be checked with the engine switched off and in a horizontal position.



The diesel engine is located at the rear area of the equipment.

Further information can be found in the enclosed additional documentation!

16.7.3 Filter diesel engine



Filter changes must be carried out by authorized personnel. For questions about filter changes please contact the service department of KLEMM Bohrtechnik.

Prerequisite: The equipment has been shut off.

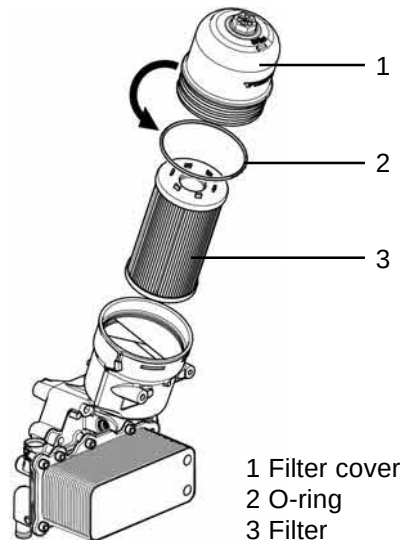
Engine oil filter

Part No. oilfilter (1 piece) 0001028668

Change interval: The filter must be changed every 500 hours (at least all 12 month).



Engine oil filter



Filter change:

Switch off the engine.

Place a collection vessel underneath the filter to avoid oil spillage.

Clean around the oil filter.

Carefully remove the filter cover (1) together with the filter.

Remove the O-ring (2) and filter (3) from the cover.

Let the oil drip off into a collection vessel.

Lubricate the new O-ring and the gasket of the new filter before installation.

Install the new filter (3) and new O-ring (2) in the filter cover. Make sure the filter is correct installed in the cover.

Install the filter cover and filter in the bracket.

Tighten the cover. Tightening torque 40 Nm.

Fill with required volume of oil; refer to manual of the diesel engine.

Start the engine and check that there is no oil leakage from the oil filter or drain nipple.

Switch the engine off and check the oil level after a few minutes. Top up with oil as necessary.

Fuel pre-filter with water separator

Change interval:

The diesel pre-filter must be changed all 1000 hours (at least all 12 month). Wasser und Verunreinigungen alle 500 Betriebsstunden ablassen.

Please note!

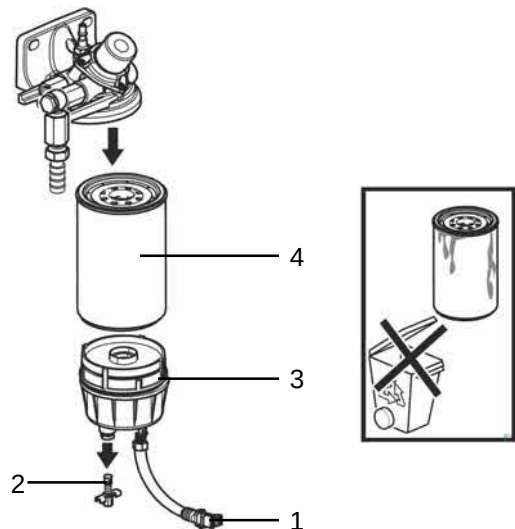
Inadequate maintenance of the fuel pre-filter results heavy damages of the engine fuel injection system!! In particular this is valid for countries which use low quality fuels.

Fuel pre-filter

Part No. filter insert (1 piece) 0001028667



Fuel pre-filter



1 Cable
2 Drain nipple

3 Water separator
4 Fuel pre-filter

Filter change:

Switch off the engine.

Put a collection vessel under the fuel pre-filter to collect the condensate and fuel.

Disconnect the cable (1) from the sensor of the water separator.

Clean thoroughly around the fuel pre-filter and water separator.

Open the drain nipple (2) in the base of the fuel pre-filter and drain the filter.

Tighten the drain nipple again.

Remove the fuel pre-filter (4) and seal together with the lower section of the water separator (3). Put the used filter in a suitable container.

Clean the lower section of the water separator and the contact surfaces.

Clean the seal surfaces thoroughly and lubricate the gasket with diesel.

Lubricate the new O-ring with diesel and install the lower part of the water separator to the new filter.

Screw the filter onto the filter bracket by hand until the rubber seal bottoms on the mating surface. Then tighten a further $\frac{1}{2}$ - $\frac{2}{3}$ turns.

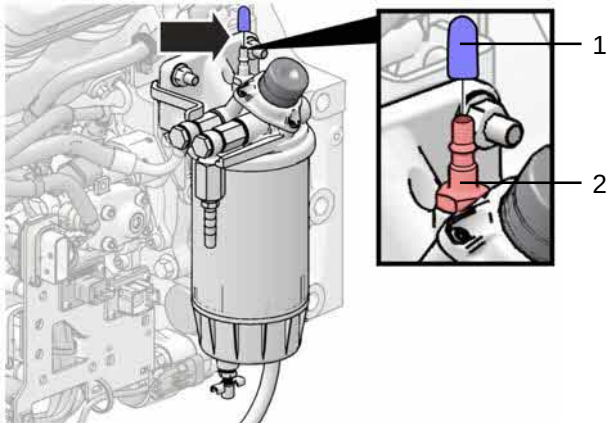
Connect the cable to the sensor of the water separator.

Open fuel taps and bleed the fuel system.

Start the engine and check that no leakage occurs.

Fuel pre-filter bleeding

It is only necessary to purge the fuel system following maintenance on the system or if a fault has caused it to run dry.



Remove the cap.

Lightly open the nipple (two turns).

Position a collection vessel.

Connect a transparent hose.

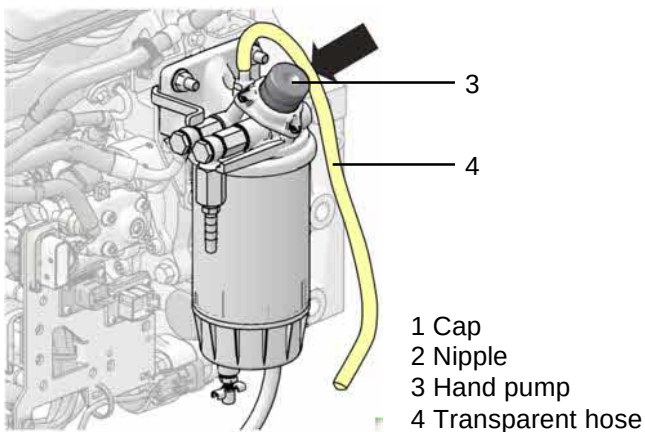
Operate the hand pump by pumping it until fuel flows without air bubbles.

Tighten the nipple while the fuel flows.

Remove the hose. Tighten the nipple.

Tightening torque 3.5 Nm.

Install the cap.



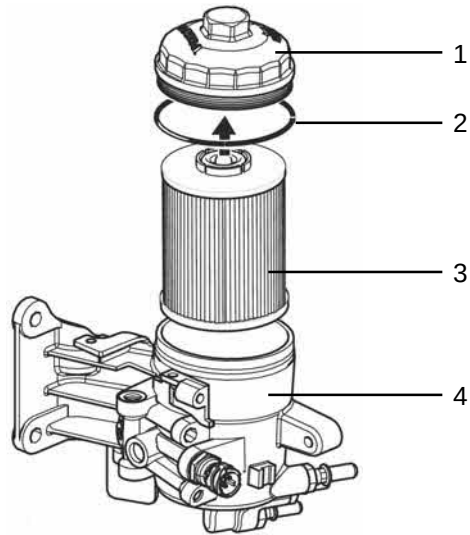
Fuel filter

Part No. fuel filter (1 piece) 0001028666

Change interval: The filter must be changed every 1000 hours (at least all 12 month).



Fuel filter



1 Filter cover
2 O-Ring

3 Filter
4 Filter housing

Filter change:

Switch off the engine.

Clean around the filter cover (1) and filter housing (4).

Put a collection vessel under the fuel filter to collect fuel.

Carefully remove the filter cover (1) and filter (3).

Remove the O-ring (2) and filter (3). Let the fuel drip off into a collection vessel.

If the filter housing (4) is completely empty, lubricate around the inner section of the filter sealing surface with diesel.

Lubricate the O-ring (2) with diesel before installing the filter cover (1).

Install the filter (3) in the filter cover (1). Make sure that the filter is fitted properly in the cover.

Install the filter cover (1) and filter (3) in the bracket. Carefully screw in the cover (1) and check that the O-ring (2) does not get twisted. Re-lubricate the seal as necessary. Tighten the cover (1). Tightening torque 25 Nm.

Bleed the fuel system (refer to instructions to bleed the fuel pre-filter).

Start and warm up the engine. Check that no leakage occurs.

Air filter (Standard)

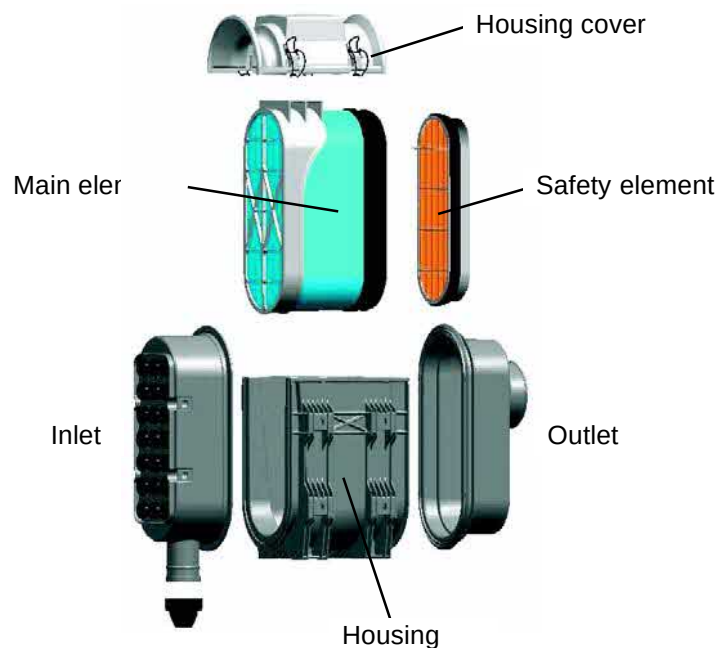
The filter housing contains a main filter element and a safety filter element. For changing the filter elements the housing cover must be dismantled.

Part no. air filter cpl. with housing (1 piece) 0000532401

Part no. main element for air filter (1 piece) 0000532393

Part no. safety element for air filter (1 piece) 0000532392

Change interval: The filter must be changed every 1000 hours (at least all 12 month).



Filter crankcase ventilation

Part No. filter (1 piece) 0001028664

Change interval: The filter must be changed every 1500 hours (at least all 12 month).



Housing
filter crankcase ventilation



Filter crankcase ventilation

Filter change:

Switch off the engine.

Clean around the filter.

Carefully remove the filter cover by hand.

Remove the filter out of the filter housing.

Insert the new filter into the filter housing.

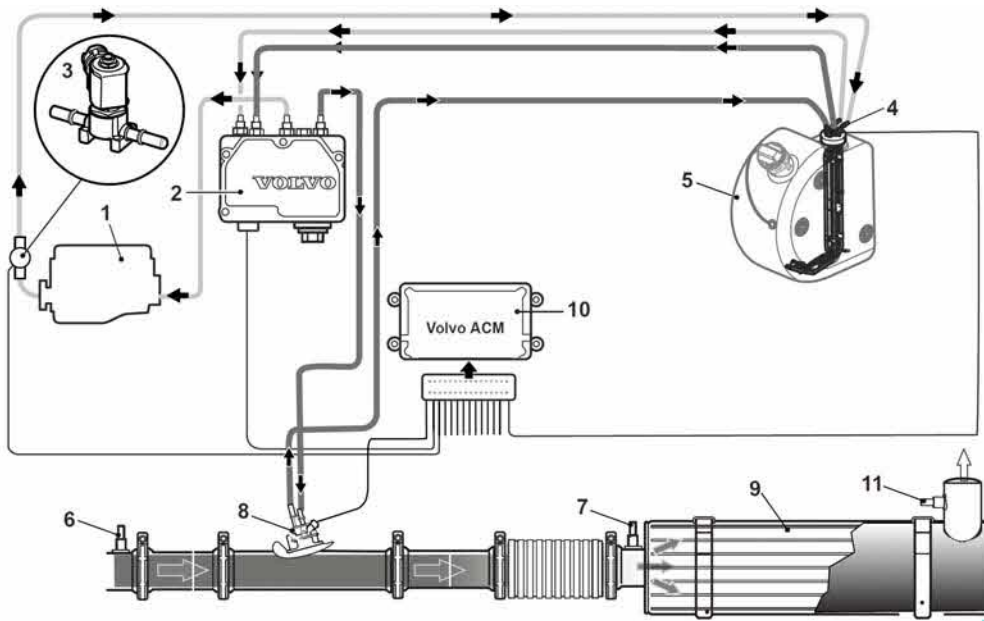
Put the filter cover carefully on the filter housing and screw it by hand.

Start the engine and check that no leakage occurs.

Exhaust Aftertreatment System (EATS)

The diesel engine of the drill rig is equipped with a Exhaust Aftertreatment System (EATS). EATS is used to reduce NOx emissions. The exhaust gases are treated through the addition of AdBlue®/DEF solution before they pass through the catalytic converter. Sensors measure NOx levels in the exhaust gases.

Scheme Exhaust Aftertreatment System (EATS)



The system comprises:

1. Engine
2. AdBlue®/DEF pump
3. Solenoid valve, when open it allows hot engine coolant to pass through the tank heating loop.
4. Urea level sensor (ULS), measures the level of the solution in the tank.
5. AdBlue®/DEF Tank
6. NOx sensor, measures level of NOx before injection.
7. Temperature sensor
8. AdBlue®/DEF Injector, the atomized solution is sprayed into the exhaust gases upstream of the catalytic converter.
9. EATS Catalyst and Muffler
10. Control unit (ACM), continuously monitors the EAT System. Activates the solenoid valve (3) at low temperature in the tank.
11. NOx sensor, measures level of NOx after the catalyst/muffler.



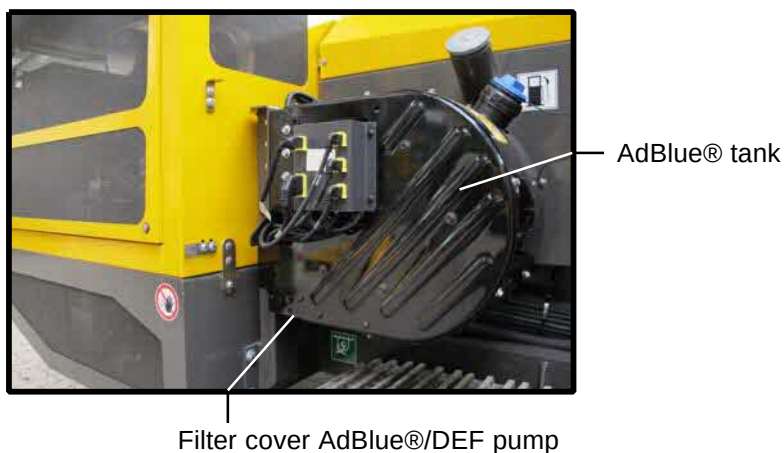
Further information can be found in the additional documentation of the engine manufacturer.

Filter AdBlue®/DEF pump

Part No. filter with service set (1 piece) 0001028665

Change interval: The filter must be changed every 2000 hours (at least all 24 month).

The filter is located on the AdBlue®/DEF pump (AdBlue® Tank).

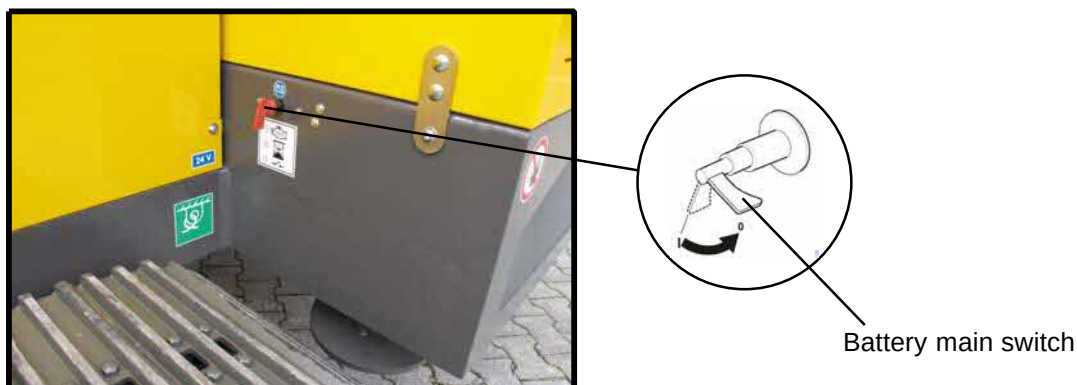


Filter change:

Switch off the engine.

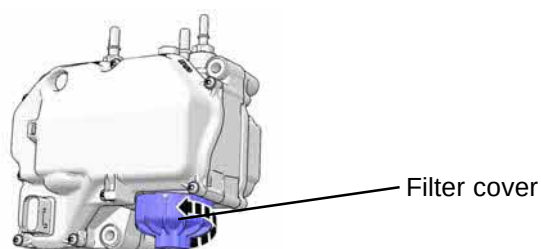
NOTICE! Wait until the pump unit has stopped running as it usually performs automatic emptying of the AdBlue®/DEF hoses.

Switch off the battery main switch.



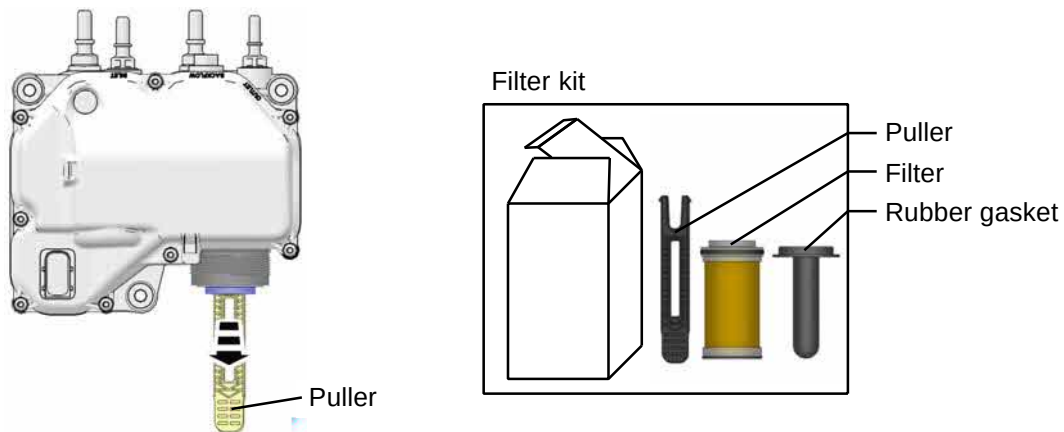
Place a suitable collection vessel under the filter cover.

Remove the filter cover.

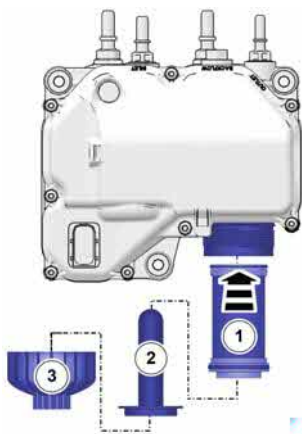


Use the puller (supplied with the filter kit) to pull out the filter by first pressing it into the filter hole until it clicks.

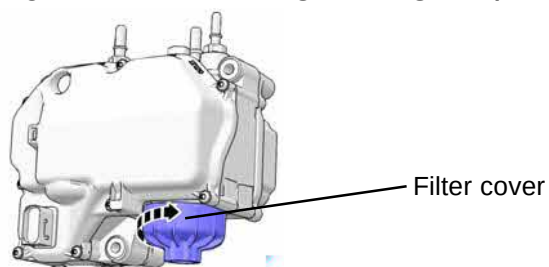
Pull out the filter.



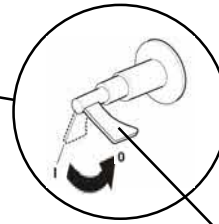
Install the new filter (1). Install the rubber gasket (2). Screw on the filter cover (3).



Tighten the cover. Tightening torque : 20 (+5) Nm.



Switch on the battery main switch.



Battery main switch

Start the engine. Check for leaks and check function.

Delete any fault codes.



Further information can be found in the additional documentation of the engine manufacturer.

16.8 Undercarriage



WARNING Risk of injury!

When performing assembly or dismantling work on tensioned crawler chains, parts can be thrown around with high speed. This can result in persons being seriously injured.

- Δ Before performing assembly or dismantling work on crawler chains, the hydraulic system of the chain tension must be pressure discharged.

NOTICE

Risk of causing damage to components!

The specified procedures for checking and adjusting the chain tension must always be observed.

Stretching of a soiled or rigid crawler chain by using the tensioning device is not permissible!

Non observation of this references leads to substantial damage to the chassis and to expiry of any warranty claims!

16.8.1 Check the chain tension

Prerequisite: The equipment has been shut off.

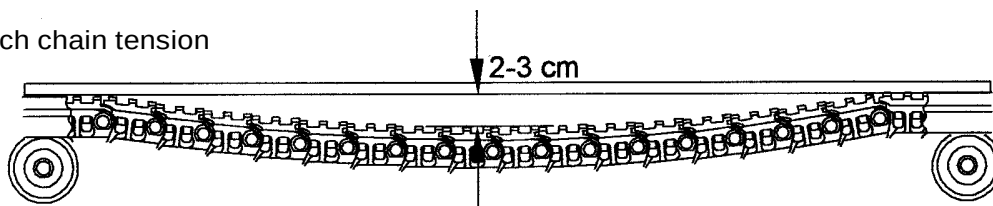
Thoroughly clean the crawlers and the sliding surfaces.

Measure the sagging of the crawler track with a level staff on a length of 1 to 1.5m.

It is to measure between two support rollers or between a support roller and the idler wheel of the crawler unit.

Chain tension is correct, if the distance between the level staff and the crawler track at the center is about 2 to 3cm.

Sketch chain tension

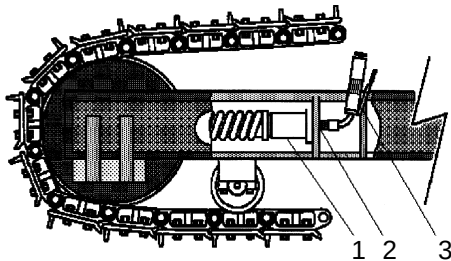


In case of a dimensional deviation adjust the chain tension accordingly.

16.8.2 Adjusting the chain tension

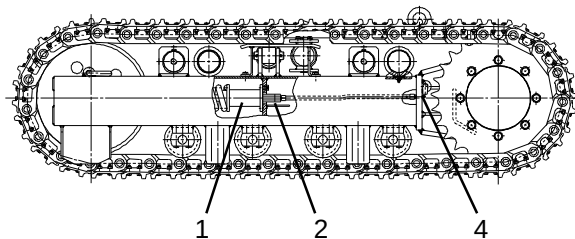
Prerequisite: The equipment has been shut off.

Sketch chain tension adjustment for standard drill rigs



1. Tensioning cylinder
2. Adapter with relief valve
3. High pressure grease gun
4. Grease nipple for high pressure grease gun

Sketch chain tension adjustment for small drill rigs



Adjusting the chain tension

Remove the cover plate (option, not illustrated) from the crawler unit.



Risk of injury! Grease escaping under pressure can cause injuries to body parts. Do not repair faulty chain tensioners. Rather have them replaced with new ones by suitably authorized technical personnel.

Clean the adapter for the high pressure grease gun on the chain tensioner.

Apply the grease nipple of the high pressure grease gun to the adapter.

Actuate the high pressure grease gun until the correct chain tension is reached. In the process, check the tensile stress of the crawler tracks several times.

Drive the equipment a short distance forwards.

Check the chain tension as described in "Checking the chain tension".

Crawler track is properly tensioned.

Clean adapter.

Mount cover plate on the crawler unit.

Tension the crawler track on the other crawler unit in the same manner.

Slackening the crawler tracks

Prerequisite: The equipment has been shut off.

Remove the cover plate (option, not illustrated) from the crawler unit.



Risk of injury! Grease escaping under pressure can cause injuries to body parts. Do not repair faulty chain tensioners. Rather have them replaced with new ones by suitably authorized technical personnel.

Unscrew the relief valve by about 3 rotations, until the grease escapes.

Check the chain tension as described in "Checking the chain tension".

When the correct chain tension is reached, tighten the relief valve again.

Drive the equipment a short distance forwards.

Check the chain tension as described in "Checking the chain tension".

Crawler track is slackened.

Clean the chain tensioner.

Mount the cover plate on the crawler unit.

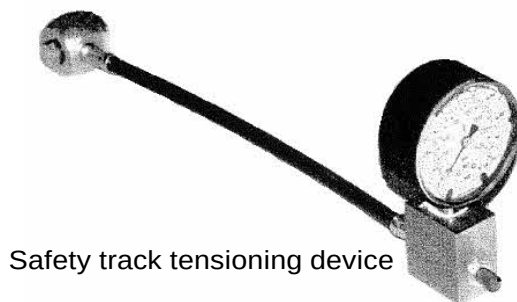
Slacken the crawler track on the other crawler unit in the same manner.

Safety track tensioning device (only be used for the corresponding adapter)

If the sag of the crawler chain is not measurable e.g. cause of soiling or strong rigidity, the chain tension must be controlled by checking the hydraulic pressure in the tensioning cylinder. For that purpose a manometer unit (e.g. grease gun with manometer) must be attached to the lubrication connection of the chain tensioning cylinder.

KLEMM Bohrtechnik offers a "safety track tensioning device" under the articles no. 0000563682. This "safety track tensioning device" is equipped with a manometer, which shows the pressure that is in the tensioning cylinder while tension.

The maximum permitted pressure in the tensioning cylinder while tension must not exceed 50 bar.

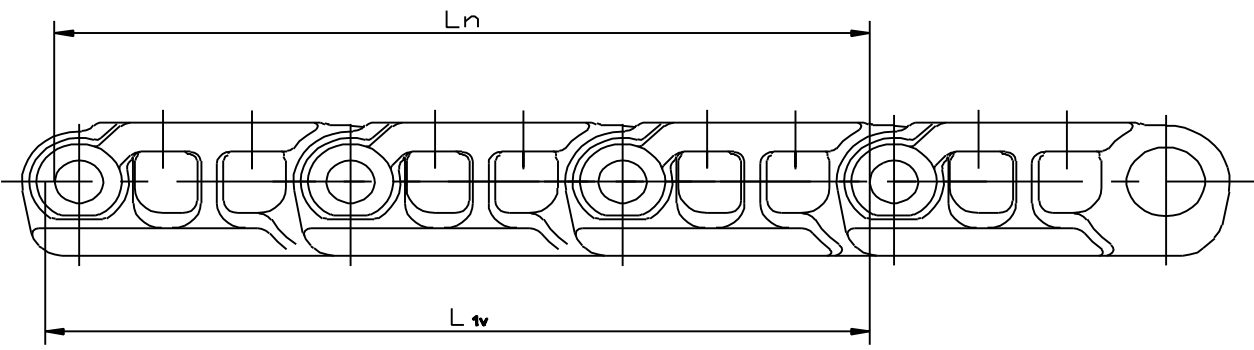


Safety track tensioning device

For setting the crawler chain after correct tension, the equipment must be moved forwards and backwards a short distance. Afterwards check the chain tension as described in "Checking the chain tension".

16.8.3 Wear limits of the crawler chains

Measurement chart of wear limits of the crawler chain		
Chain type	Dimensions of new chain	Dimensions to renew chain
	L_n	L_{1v}
B00	407,15	419,3
B1	560,9	577,0
B2	623,3	642,0
B4	685,1	705,7
B4	685,1	705,7
B6	812,1	836,5
B7	864,5	890,4
B8	915,3	942,8



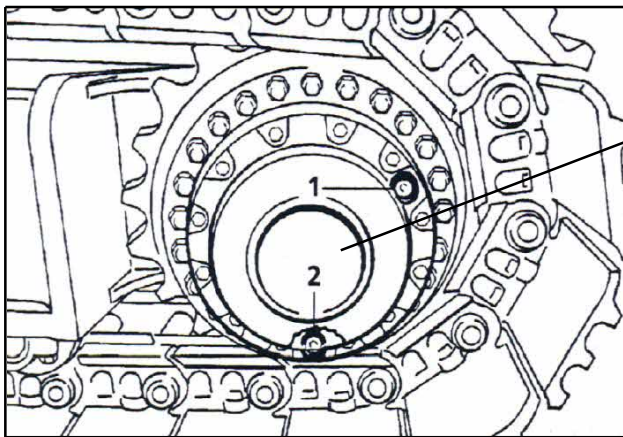
The diagram shows a side view of a crawler chain with multiple links. Two horizontal dimension lines are shown: the top one is labeled L_n and spans the length of the chain from the center of the first pin to the center of the last pin; the bottom one is labeled L_{1v} and spans the length from the center of the first pin to the center of the last pin, including the end links.

16.8.4 Check oil level / change oil of driving gear

Necessary checks on driving gears

Check leak tightness : daily
Check oil level : all 200 - 250 operating hours
Change oil : first change after approx. 200 operating hours. Each further oil change after 2000-4000 operating hours, at latest after 12 months.

Check oil level



Driving gear

Position the equipment such that the screw plug of the discharge opening (2) is at the deepest point.

Remove the screw plugs from the filler openings (1). The oil level is below the lower edge the opening (1).

Replenish the oil as described in "Changing the oil".

Oil level is correct if it reaches the lower edge of the filler openings (1).

Clean the screw plugs of the filler opening (1) and the sealing surfaces.

Check seals for integrity and wear.

Replace damaged or worn seals with new ones.

Replace the screw plugs in the filler openings (1).

Oil level has been properly checked.

Changing the oil

Position the equipment such that the screw plug of the discharge opening (2) is at the deepest point.

Remove the screw plugs from the filler openings (1).

Place a suitable container for catching the old oil beneath the screw plug of the discharge opening (2).

Remove the screw plug from the discharge opening (2).

Old oil flows into the prepared container.

Clean the screw plug of the discharge opening (2) and the sealing surfaces.

Check seals for integrity and wear.

Replace damaged or worn seals with new ones.

Replace the screw plug in the discharge opening (2).

Pour the new oil into the filler opening (1) with the help of a suitable filling unit.

Check the oil level as described in "Checking the oil level".

Clean the screw plugs of the filler opening (1) and the sealing surfaces.

Check seals for integrity and wear.

Replace damaged or worn seals with new ones.

Replace the screw plugs in the filler openings (1).

Dispose of the old oil in an environmentally friendly manner.

The oil change has been properly carried out.

16.9 Electrical system

16.9.1 Checking the batteries

The installed batteries are MAINTENANCE FREE!

The operability of the starter battery depends on the adequate recharge by the alternator.

Check the cable connections of the batteries for proper working order.

As protection against corrosion and creeping current caused by humidity, protect the battery terminals by using terminal grease.

16.9.2 Checking the fuses

Check that the fuses are complete. Replace missing fuses with new ones.

Check fuses for soiling and clean if necessary.

Check fuses for damage and corrosion and replace if necessary.

Replace defective fuses with new ones.

16.10 Fire extinguishers



Information on the individual positions of the fire extinguishers on the equipment can be found in "Safety and protective equipment".

Check all fire extinguishers for completeness and proper working order.

Have all fire extinguishers checked in accordance with the national or regional regulations (in Germany DIN 14466 Part 4).

Promptly replace fire extinguishers which are missing or damaged and/or have passed the expiry date.

16.11 Steps/platforms/handrails

Visually check that the components are complete, securely fitted, and intact (e.g. damage, cracks, wear, corrosion, bending).

Replace damaged, loose or missing components with new ones.

Check the integrity of the paintwork and repaint if necessary.

Check connection elements for completeness, firm seating and integrity.

Tighten screw connections as needed.

Check locking elements for completeness, firm seating and integrity.

Replace damaged, loose or missing connection elements and locking elements with new ones.

Check that the locking mechanisms are in proper working order.

Clean the platforms and handrails.

17 Environmental protection/disposal

17.1 General

Any work on and with the equipment must be done in compliance with legal obligations pertaining to waste disposal and proper recycling/disposal. Any additional documentation must be observed for specific types of work.



In nature conservation areas, more comprehensive measures than those described here may be in effect.

17.2 Storing and transporting equipment, units, consumables and operating materials

The following components must be emptied, cleaned, sealed shut and acceptably protected from leakage prior to transport and storage:

- Capped hoses
- Hoses and hose connectors
- Engine compartment
- Fuel tank
- Oil tanks

Suitable and sufficiently large containers must be placed in order to catch oil and fuel. When disconnecting hydraulic connections, changing oil and performing repairs, make sure no oil seeps into the soil through the ground. Filling/emptying e.g. oil tanks/hydraulic lines must be constantly monitored.

Grease and oil build-up on components must be removed before storage (steam cleaner). Oily waste water must be purified using a suitable station.

Consumables and operating materials such as greases and oils, fuels, coolants or cleaners must be kept in suitable and properly labeled containers.

Appropriate storage conditions must be reasonably provided when storing hydraulic lines and hoses. Eventual aging and the associated change in material properties and binding properties must be kept to a minimum. Maximum storage time should not exceed two years for hydraulic lines and hoses. Hydraulic lines and hoses that have been kept in storage for longer periods must be inspected for visible damage and deficiencies prior to use. Inspection may only be carried out by persons who possess the necessary expertise for inspecting hydraulic lines and hoses from their professional training, professional experience and recent occupational responsibilities.

All components, particularly hoses, lines and fasteners must be regularly inspected for leaks/visible damage for the duration of storage. Any damage must be remedied by properly authorized skilled personnel.

Equipment components and containers with capacities exceeding 20 l (5.3 gal) may only be stored on reinforced surfaces (concrete or pavement). If storage on unreinforced ground is necessary, no oil or fuel may leak out onto the ground.

17.3 Information on cleaning the equipment

All openings in which no cleaner may enter for safety and/or function reasons must be covered accordingly before cleaning the equipment with water. Electronic components such as electrical boxes and electrical motors are particularly sensitive.

Cleaning may only be done in special areas with suitable equipment where no liquid contaminants can seep through the soil into the groundwater.

After cleaning, all components on the equipment, in particular fuel lines and oil lines, must be checked to ensure they are in proper working order. Have any defects remedied immediately.

17.4 Shutdown



See Chapter "Decommissioning" for the individual steps on shutting down the equipment.

Shut down the equipment.

Disconnect the equipment from power.

Remove any operating materials, lubricants and consumables.

The equipment has now been shut down.

17.5 Disassembling the equipment

Prerequisites: Equipment has been completely shut down and cleaned.

Disassemble the equipment accordingly and place individual components on suitable surfaces using an appropriate lifting device.

Disassemble any steel constructions that cannot be disassembled without destruction into transportable parts by flame cutting or another appropriate process.

Disassemble the components and sort separately by material.

The equipment has now been completely disassembled.

17.6 Disposal

Applicable laws and regulations on-site must be observed when disposing of equipment components. Be sure that materials and assemblies can also be easily recycled, disassembled and separated and take environmental hazards and health risks into consideration when recycling and disposing.

17.6.1 Disposing of operating materials, lubricants and consumables

Operating materials, lubricants and consumables may only be stored separately in suitable containers that are appropriately labeled. Used operating materials, lubricants and consumables must be treated as hazardous waste. The disposal of this kind of waste must be performed by special companies according to applicable legal regulations.

In order to allow environmentally friendly recycling, mineral oil may not be mixed with the following materials:

- Fuels (e.g. gasoline, diesel, heating oil)
- Antifreezes
- Brake fluids
- Vegetable oils
- Glycol-based oils
- Cleaners, chemicals, emulsions
- Halogen products, CHC, PCB

Ester-based synthetic hydraulic oils (bio-oil) can generally be disposed of along with used mineral oil after consulting the disposal company.

The containers for storing used oil must be absolutely protected against penetration from rain-water.

Never dispose of used oil in the environment (ground, water, drains). The same applies e.g. for antifreezes, brake fluids, cleaners, fuels, chemicals, emulsions and halogen products. These products must be given to an appropriate disposal company.

17.6.2 Disposing of metal components and synthetics

Metals and synthetics of various kinds must be sorted and given to the proper recycling/disposal process.

17.6.3 Disposing of electrical and electronic components

Electrical and electronic components of various kinds must be sorted and given to the proper recycling/ disposal process.

17.6.4 Hazardous waste

Hazardous waste poses an increased risk to humans and the environment and is subject to special legal regulations. Hazardous waste in particular includes:

- All used operating materials, lubricants and consumables.
- All acid-containing components (e.g. batteries).
- All containers and their feeds and drains.
- Oil filters.
- Lines and hoses used to transport operating materials, lubricants and consumables.
- Pressure containers for storing gases.
- All contaminated components and materials.

17.6.5 Recycling

Individual equipment components can be accepted for suitable recycling and used for new applications.